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A STUDY OF ORGANIZATIONAL INFORMATION
SEARCH, ACQUISITION, STORAGE AND RETRIEVAL

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for

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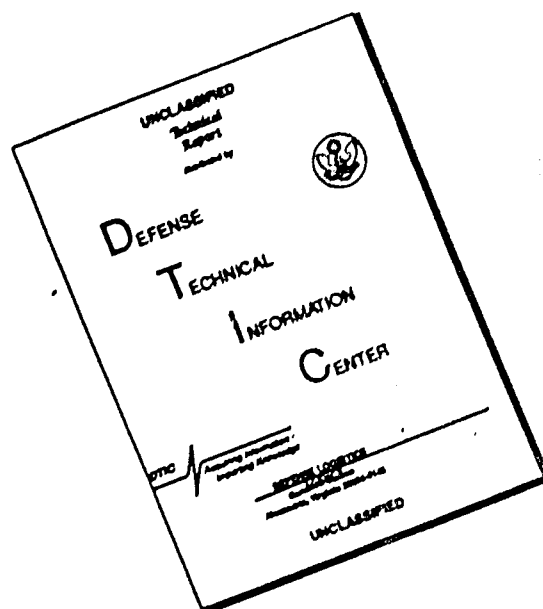
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Section 3 introduces the idea that the domains of existing organizational design paradigms are declining in scope, and that the nature of current and future organizational environments requires use of a design paradigm that responds to the increasing frequency and criticality of the decision making process.

Section 4 introduces the idea that the limitations of available information distribution technologies constrain the designs of organizations. When new technology with fewer limitations arrives, it ought to be exploited by creating more effective organizations.

Section 5 is a critical review of the literature on the systems paradigm and its relationship to the development of organizational theory. Mistaken beliefs have repeatedly appeared concerning this topic and many opportunities remain unexplored.

Section 6 describes both research and conceptual needs in the area of organizational design.

Introduction

This document is the Final Report on Contract MDA 903-83-C-0440, "A Study of Organizational Information Search, Acquisition, Storage and Retrieval." The purpose of the study reported was to determine what is known and is not known about these organizational processes so that potential researchers and research resource providers might be wiser in their choice of research topics to study.

The Report contains six main sections. Section 1 is a review of what is and is not known about the information environments that organizations face and create, where "information environment" is defined as the information-based representation of the actual environment. It is the information environment that determines the choices of organizational decision makers. A somewhat revised version of this section is to appear as a chapter in the forthcoming Handbook of Organizational Communication, published by Sage Publications, Inc., and having as editors Fredrick Jablin, Lyman Porter, Linda Putnam, and Karlene Roberts. The last several pages of this section describe a number of research needs identified through the review.

Section 2 is a review of what is and is not known about organizational learning. An important conclusion of this review is that there are several different perspectives associated with the subject of organizational learning. About one of the two primary perspectives, the systems-structural perspective, a good deal is known--the perspective is well-defined and has associated with it a considerable body of published empirical research. About the other, the interpretive perspective, a modest amount of theorizing has taken place but little empirical research has been conducted and little is known. A major thrust of the review is the suggestion that the two perspectives can be usefully linked with a communications framework. This review will appear in its present shown here as a chapter in the fifth (1986) volume of the annual, Research in the Sociology of Organizations. The last several pages of this section describe several research implications identified through the review.

Section 3 introduces the idea that the domains of existing organizational design paradigms are declining in scope, and that the nature of current and future organizational environments requires use of a design paradigm that responds to the increasing frequency and criticality of the decision-making process. The section then explicates a decision-making paradigm of organization design and examines the relationships between the paradigm and the literatures on the information-processing view of organizations and on technologically supported information systems. Ten organization design guidelines are derived, most involving the acquisition and distribution of information. This section has recently been published as a journal article in the May 1986 issue of Management Science.

Section 4 introduces the idea that the limitations of available information distribution technologies constrain the designs of organizations and also the idea that when new technology with fewer limitations arrives it ought to be exploited by creating more effective organizations. This section will soon appear as a chapter in the forthcoming volume, Managers, Micros, and Mainframes, published by John Wiley and Sons and edited by Mathias Jarke.

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Section 5 is a critical review of the literature on the systems paradigm as this literature is associated with the development of organization theory. Major findings are that two mistaken beliefs have repeatedly appeared in the organization theory literature concerning application of the systems paradigm to organizations and also that there are unexploited opportunities to use the systems paradigm to further the development of organization theory. Both the mistaken beliefs and missed opportunities involve the open systems and information processing models of organizations. This section is to be presented at the 1986 national Academy of Management Meeting.

Section 6, like the previous sections, is a product called for in the list of research products called out in the proposal that led to Contract MDA 903-83-C-0440, of which this document is the Final Report. In particular the section describes research needs in the area of organization design and is a proposal to conduct theoretical and empirical research in organizational design (with emphasis on the view of organizations as information processing systems). The research proposed in the section has been funded by ARI.

The next few pages contain the Abstracts of the products comprising Sections 1-6 respectively.

INFORMATION ENVIRONMENTS

Abstract

This chapter is about information environments, environments characterized by the information they contain. In it we examine three types of environments that affect and are affected by organizational communications. In aggregate, these three environments are the overwhelming determinates of the frequency and content of organizational communications.

- (1) The organization's external environment. The external environment contains opportunities and problems for the organization, and also contains information about these opportunities and problems. This information is used by the organization's members to create and maintain desirable relationships between the organization and its environment.

Since it is hardly ever the case that an organizational member unilaterally obtains organizationally relevant information, decides what action to take, and implements that action, intra-organizational communication is required. This leads to a second information environment:

- (2) The organization's internal information environment. Organizations create and process information about both their external environment and their internal environments (such as their resource status or their progress on decision implementation). The internal information environment is determined by organizational communications.

The third information environment is partly determined by the first two:

- (3) The organizational members' personal information environments. Individual organizational members both select and have imposed on them different information environments. To a great extent, both their actual information environments and their perceived environments are the consequence of organizational communications.

HOW ORGANIZATIONS LEARN:
A COMMUNICATION FRAMEWORK

Abstract

What is known about organizational learning is principally found in two perspectives, the systems structural perspective and the interpretive perspective. The literatures associated with the perspectives are described. The perspectives themselves are first contrasted and then, using a communications framework, are shown to be closely linked. The communications framework involves and elaborates the constructs of information equivocality, information load, and media richness.

THE DECISION MAKING PARADIGM OF ORGANIZATIONAL DESIGN

Abstract

This paper introduces and explicates the decision-making paradigm of organizational design. We argue that the domains of existing design paradigms are declining in scope, and that the nature of current and future organizational environments requires use of a design paradigm that responds to the increasing frequency and criticality of the decision-making process. In particular, we argue that the decision-making paradigm is applicable when the organizational environments are hostile, complex, and turbulent.

The focal concept of the decision-making paradigm is that organizations should be designed primarily to facilitate the making of organizational decisions. The paper sets forth the paradigm's six major concepts and discusses the principal domains of its application. The paper also examines the relationships between the decision-making paradigm and the literatures on (1) organizational decision making, (2) the information processing view of organizations, and (3) the need for compatibility between the organization's design and the design of its technologically supported information systems. The paper concludes by identifying ten organizational design guidelines that follow from the decision-making paradigm.

EXPLOITING INFORMATION TECHNOLOGIES TO DESIGN
MORE EFFECTIVE ORGANIZATIONS

Abstract

Organization design have historically been constrained, generally implicitly, by the state of available information technology. Information systems themselves are generally constrained to fit within the current designs of the organizations implementing them.

It is important that we change this state of affairs. When new information processing technologies are being considered, information systems designers and line managers must consider not only what benefits the technologies could provide if they were superimposed on the existing organization, but must also think creatively about what benefits the technologies could provide through facilitating the introduction of more effective organizational structures and processes. What organizational design options are opened up with evolving and forthcoming information processing technologies? We will address this question in this chapter, and provide guidelines for exploiting information technology to design more effective organizations.

THE SYSTEMS PARADIGM IN THE DEVELOPMENT
OF ORGANIZATION THEORY:
CORRECTING THE RECORD AND SUGGESTING THE FUTURE

Abstract

Two mistaken beliefs have repeatedly appeared in the organization theory literature concerning application of the systems paradigm to organizations. This paper identifies and corrects these beliefs. Three opportunities for using the systems paradigm to further the development of organization theory have been overlooked. The paper identifies these opportunities and suggests how they can be exploited. Finally, the paper notes that recent advances in organization theory could enrich the paradigm, making it more useful for organization research.

ORGANIZATIONAL DESIGN
Proposed Theoretical and Empirical Research

Abstract

This document proposes a program of research to be undertaken on behalf of and with support from the Army Research Institute for the Behavioral and Social Sciences. The proposed research focuses on organizational design. The objective is to improve in social scientists' understanding of organizational design and administrators' ability to design more effective organizations.

The proposed program of research has eight unique and important features.

1. The most important issues in organizational design will be investigated by uniquely qualified researchers chosen from around the country, rather than from the local talent at one university or consulting firm.
2. The researchers (the principal and co-principal investigator and the four associate principal investigators) will each be supported by a team of consultants consisting of five nationally recognized scholars specially selected from around the country for their ability to contribute to a program of research on organizational design.
3. The program of research will be an integrated and coordinated effort, rather than being a set of unrelated projects. The principal and co-principal investigator and the consultants will be in frequent contact with the associate principal investigators. Further, all investigators and consultants will meet together annually to report, review, assess, and revise as necessary their individual and collective efforts. This rich exchange of perspectives and constructive suggestions will enhance the quality of both the individual and collective research efforts.
4. The involvement of multiple investigators makes it possible to conduct an integrated study using data drawn from a very large and diverse set of organizations. This will eliminate problems of small sample size and range restriction of the variables, problems that occur in most organizational design studies.
5. The program emphasizes longitudinal studies of organizational design. The advantages and infrequency of longitudinal research are well known, especially in the area of organizational design.
6. Where appropriate, the empirical results will be analyzed using both multivariate statistical techniques and data envelopment analysis.
7. The multiplicity of studies will allow for the planned development of a contingency theory that accounts for differences in

organizational missions, strategies, technologies, and environments.

8. The planned derivation of normative organizational design guidelines will provide immediate benefits to the administrative community, without compromising basic research objectives.

Hardly any of the above features and outcomes would occur if the subject of organizational design were approached with the independent, cross-sectional studies that pervade the field.

INFORMATION ENVIRONMENTS*

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March 4, 1986

*Preparation of this chapter was supported in part by
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and Social Sciences.

INFORMATION ENVIRONMENTS

Abstract

This chapter is about information environments, environments characterized by the information they contain. In it we examine three types of environments that affect and are affected by organizational communications. In aggregate, these three environments are the overwhelming determinates of the frequency and content of organizational communications.

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- (3) The organizational members' personal information environments. Individual organizational members both select and have imposed on them different information environments. To a great extent, both their actual information environments and their perceived environments are the consequence of organizational communications.

1. INTRODUCTION

This chapter is about information environments, environments characterized by the information they contain.¹ In it we examine three types of environments that affect and are affected by organizational communications. In aggregate, these three environments are the overwhelming determinates of the frequency and content of organizational communications.

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In sections 2, 3, and 4 of this chapter we delineate more sharply the nature of these three environments. In section 5 we suggest the nature of the research required to increase our understanding of information environments. We turn now to a discussion of external environments, as these affect greatly both the internal information environment and the personal information environments of organizational members.

2. EXTERNAL ORGANIZATIONAL ENVIRONMENT

In this section we examine the relationships between the external organizational environment and the information environment perceived by organizational members. As a first step, we briefly review the two dominant organizational science perspectives on the organization's external environment.

2.1 The Resource-Dependency and Information-Processing Perspectives

Organizational environments contain resources upon which the organization depends for achieving its goals, such as survival. The focus on this fact is called the the resource-dependency perspective or the resource perspective (Aldrich and Mindlin, 1978; Ulrich and Barney, 1984). From the resource-dependency perspective, for example, an organization's size would be explained by the number of customers available in the environment and its technology would be explained by the availability and cost of alternative technologies. Munificence is an environmental characteristic frequently examined by proponents of this perspective

Closely related to this perspective is the view of the environment as a network of interorganizational relationships (Benson, 1978). This view

assumes that other organizations comprise the relevant external environment because they influence access to critical resources (Walker and Van de Ven, 1984). For example, competitors influence access to customers, suppliers influence access to technology, and government agencies influence access to land. Like any perspective it is bounded by the faithfulness of its representations of reality; rainfall as a resource for ranchers is not controlled by other organizations (but substitutes for rainfall are). Hostility and competitiveness/cooperativeness are environmental characteristics of interest to those who focus on interorganizational relationships (Miles, 1986).

The processes through which the environment influences an organization's characteristics, such as its communication patterns or its production technology, are not included within the resource perspective. In contrast, the "information perspective" deals explicitly with the processes through which the environment influences organizational processes especially communication processes.

Organizations extract and process information from their environment. The focus on this fact is called the information-processing perspective or information perspective (Galbraith, 1977; Tushman and Nadler, 1978; Aldrich and Mindlin, 1978). Some of the varied purposes served by this extraction include the following:

- (1) identifying externally-based opportunities and problems that may have action implications,
- (2) deciding which opportunities and problems to act upon and what actions to take,

- (3) developing interpretations and understandings of the environment which may later facilitate long-run achievement of the first two purposes,
- (4) satisfying the needs of individuals, e.g., to reduce the personal tension associated with uncertainty or to possess information for use as a source of influence.

The focus of the information perspective is on information about the environment, how this information affects the perceptions of organizational members, and how these perceptions then trigger actions that in turn affect organizational structures, processes, power distributions, communications, and so forth. The perspective includes or is related to several topics of interest to researchers in organizational communications: (1) perceived environmental uncertainty, (2) organizational information processing, and (3) acquisition of information by individuals. The first of these we examine later in this section on external organizational environments. The second topic introduces the organization's internal information environment, an environment that we examine in section 3. In section 4 we discuss personal information environments, especially the development of personal information environments by managers.²

2.2 Characteristics of External Environments

Organizational scientists and others have created typologies of characteristics for describing external organizational environments (Emery and Trist, 1965; Miles, Snow, and Pfeffer, 1974; Jurkovich, 1974; and Scott, 1981). Among the more thorough discussions of external environments are those by Aldrich and Pfeffer (1976), Starbuck (1976), Aldrich (1979), and Meyer and Scott (1983). Pioneering conceptualizations were those of Emery and Trist (1965) and Terreberry (1968). A factor-analytic classification is

that of Dess and Beard (1984). The three characteristics most often discussed in the context of organizational communication and information processing are environmental complexity and turbulence and the information load that the environment imposes.

Complexity can be conceptualized as having four components: (1) numerosity, (2) dispersion, (3) heterogeneity, and (4) interdependence. If an organization's relevant environment has numerous elements that must be monitored, then the organization must generally allocate more resources to environmental scanning than if the elements are fewer. If the environmental elements are dispersed rather than concentrated, this too generally requires the organization to allocate more resources to scanning. If the environment is composed of unlike elements, the organization's scanning units must generally be more specialized than if the elements are homogeneous--Ashby's Law of Requisite Variety (Ashby, 1956). If the elements have interdependencies that are important to the organization, then the organization's intelligence system (Wilensky, 1967) must possess a significant interpretive capability. This interpretive capability is largely determined by the distribution and effectiveness of organizational communications (Galbraith, 1977; Daft and Huber, 1986).

The classic example reported by Emery and Trist (1965) captures the essence of both interconnectedness and inability to interpret interconnectedness, and was summarily described with "the changed nature of the environment was not recognized by anyone but traditional management until it was too late. They failed to appreciate that a number of outside events were being connected with each other in a way that was leading to irreversible general change" (Emery and Trist, 1965, p. xx).

Turbulence can be thought of as having two components: (1) instability and (2) randomness. Instability refers to the frequency of change. Randomness refers to the unpredictability of the frequency of change. When their environments are turbulent, organizations attempt to protect their core technology, their central activity, from the consequences of this turbulence (Thompson, 1967). They also create processes and structures that maintain their ability to adapt to changes. Thus we have the literatures on mechanistic versus organic structures (Burns and Stalker, 1961; Lawrence and Lorsch, 1967; Miles, Snow, Meyer, and Coleman, 1978) and on experimenting organizations (Hedberg, Nystrom, and Starbuck, 1976, 1977).

Information load is a function of those characteristics of the environmental information that affect the difficulty of information processing and use, e.g., quantity, specificity, and variability. Although the information load imposed on an organization by its environment is thought to be an important determinant of organizational performance (Driver and Streufert, 1969; Miller, 1972; Simon, 1973; Huber, 1984a), it has been empirically studied only infrequently; (but see Meier, 1963, Huber, O'Connell, and Cummings, 1975, and Gifford, Bobbitt, and Slocum, 1979). The effects of information load on organizational structures and processes are akin to the effects on the coping behaviors of individuals (Driver and Streufert, 1969; Farace, Monge, and Russell, 1977) and include, for example specialization and prioritization.

It is apparent that all three of these environmental characteristics are increasing (Toffler, 1980; Naisbett, 1982) and that the increases will continue to affect the structures and processes of organizations (Simon, 1973; Huber, 1984a). It is also apparent that by choosing their environments, organizations can cause themselves to be faced with quite

different levels of these characteristics. For example, if a firm explicitly chooses as a strategy to be a Prospector and compete on the basis of being first with new products or services in newly created markets, it will tend to encounter higher levels of environmental complexity, turbulence and information load than will a firm that chooses to be a Defender and thus to compete on the basis of delivering high quality, low-cost goods and services to old, well-known customers (Miles and Snow, 1978). Perrow (1970) takes the argument one step further and notes that if a prison implicitly views its task as one of serving as a custodian, it will tend to see its environment as relatively uncertain. On the other hand, if the prison views its task as rehabilitation, it will tend to view its environment as more uncertain. Thus one consequence of such choices is "perceived environmental uncertainty" (PEU), the uncertainty that the organization's members perceive as characterizing the external environment.

2.3 Perceived Environmental Uncertainty

"Uncertainty is a term which is used daily in a variety of ways. This everyday acquaintance with uncertainty can be seductive in that it is all too easy to assume that one knows what he is talking about. This problem is not new to organizational research" (Downey, Hellriegel, and Slocum, 1975, p. 562). Since this statement was made, organizational scientists have made modest progress in advancing their understanding of uncertainty. Our goal in this subsection is to provide additional conceptual clarification and to review the findings to date.

Conceptual issues. It seems reasonable that some characteristics of an organization's environment would affect an observer's feelings about how certain he or she was concerning what will happen in the environment or why something did happen. Some authorities have used the concept of

environmental uncertainty as if it were a characteristic of the environment itself (Thompson, 1967). Others have used it in reference to the perceptions that individual organizational members have about the environment (Duncan, 1972; Galbraith, 1977), in which case it is generally referred to as "perceived environmental uncertainty" (PEU).

The latter conceptualization of uncertainty, as a function both of the environment and of the perceiver, seems more useful in light of three nearly universal findings. The first of these is that basic environmental characteristics, such as complexity, turbulence, and load, influence PEU. The second is that PEU is affected by organizational structures and processes. The third finding is that PEU is affected by personal characteristics.

Another conceptual issue is apparent from the approaches used to assess PEU. One approach has been to focus on the construct of information as a counterpart of uncertainty and thus to assess PEU using the classic information theory measure of uncertainty in which "uncertainty and information have a clear and inverse relationship" (Gifford, Bobbitt, and Slocum, 1979) and where uncertainty is an algebraic function of the probabilities of the several possible environmental states (Huber, O'Connell, and Cummings, 1975; Leblebici and Salancik, 1981).³ The other approach has been to use Likert-type scales to assess organizational members' feelings or confidence about how well they could predict or explain the environment (Duncan, 1972; Downey, Hellriegel, and Slocum, 1975). The approach using (subjective) probabilities seems to obtain more cognitively-based responses; the Likert-scale approach would seem to obtain more affectively-based responses.

Should PEU be assessed as a subjective estimate of an environmental characteristic or as an expression of a state of mind? This is clearly an important conceptual issue, similar to the issue of objective versus enacted environments (Weick, 1979; Smircich and Stubbart, 1985). Bearing on these issues is Bourgeois's (1985) finding that a poor match between true environmental uncertainty and top management's perceived environment uncertainty was associated with low economic performance by the firm.

Let us turn now from highlighting conceptual issues to examining some of the empirical findings. The literature contains studies of three possible determinants of PEU: (1) the characteristics of the organization's external environment; (2) the structure of the organization, and (3) the characteristics of the perceiver.

Environmental determinants of PEU. Environmental characteristics examined for their possible effect on PEU include complexity, turbulence, routineness of problem/opportunity states, and information load. In his early and often-referenced study, Duncan (1972) found that high levels of complexity and high levels of turbulence were associated with high levels of PEU, with turbulence having more effect than complexity. These findings were replicated by Tung (1979). It appears, however, that the component measures of PEU may have been summed incorrectly in these studies (Downey, Hellreigel, and Slocum, 1975), and a study specifically designed to replicate Duncan's results obtained quite different results (Downey, Hellriegel, and Slocum, 1975). In addition to replicating Duncan's results, Tung (1979) investigated the routineness of problem/opportunity states and found a positive relationship between it and PEU. Leblebici and Salancik (1981) used a measure of PEU different from Duncan's and found PEU to be correlated with an objective measure of environmental turbulence.

Two studies have examined the relationships between a global measure of perceived uncertainty and three component perceptions of the environment: (1) lack of clarity of information, (2) general uncertainty of causal relationships, and (3) time span of feedback about results (Lawrence and Lorsch, 1967; Tosi, Aldag, and Storey, 1973). As noted by Downey, Hellreigel and Slocum (1975), methodological issues make it difficult to draw conclusions about the results of these two studies as well. However, in laboratory simulations of decision situations, Huber, O'Connell, and Cummings (1975) found that the amount of information about the environment and the specificity of messages about the environment affected PEU, and Gifford, Bobbitt, and Slocum (1979) found that the quality of messages about the environment affected PEU. Overall, in spite of methodological problems of unknown effect in some of the relevant studies, the preponderance of evidence is congruent with one's intuition--the organization's external environment, or more precisely the information environment representing the external environment, is a determinant of PEU.

Structural determinants of PEU. It is commonly believed that organizations adapt their structure to their environment, that PEU determines structure. For example, if its environment is turbulent, the organization would adopt an organic structure (Burns and Stalker, 1961; Miles, Snow, Meyer, and Coleman, 1978). The belief appears in the reports of cross-sectional studies where correlations were found between PEU and organizational processes (Conrath, 1967) or structures (Duncan, 1973, 1974). Of course such correlations could be a consequence of structure determining PEU. In a war game simulation involving ROTC cadets and Air Force Academy cadets, Huber, O'Connell and Cummings (1975) found that experimental manipulation of structure did in fact affect PEU, that tightly structured

groups perceived more uncertainty about the environment than did loosely structured groups. A subsequent cross-sectional field study using partial correlational analyses of data on PEU, structure, and process also suggested that structure affects PEU (Leifer and Huber, 1977). Possible explanations for these findings are that tight structures buffer some organizational members from the external information environment or that loose structures facilitate informal processes that may increase or decrease PEU depending on the specificity of the information exchanged (O'Connell, Cummings, and Huber, 1975; Daft and Lengel, 1983).

Personal determinants of PEU. Strong arguments can be made that the characteristics of individuals affect their perceptions of their environments (Downey and Slocum, 1975; Kiesler and Sproull, 1982). Hunsaker (1973) and Downey, Hellreigel, and Slocum (1977) found cognitive constructs such as tolerance for ambiguity and cognitive complexity to be related to PEU, although Gifford, Bobbitt, and Slocum (1979) did not. It appears that such personal characteristics are related to PEU when "general" measures of PEU are used, but that when task-related measures of PEU are used, the effect of personal characteristics on PEU is considerably less (Lorenzi, Sims, and Slocum, 1981).

Consideration of individual difference determinants of perceived environmental uncertainty surfaces the issue of the unit of analysis under discussion. Why in this section on the external environments of organizations are we discussing personal determinants of PEU? Downey and Slocum (1975) respond to this question in depth. We quote just the opening sentences of their discussion.

This perceptual view of uncertainty raises the issue of how total organizations relate to uncertainty. Zaltman et al. (35), while discussing innovation, suggests that all those factors which influence individual perceptions directly or indirectly influence

the organization's perceptions. The present authors would tentatively take this one step further and suggest that an organization's perceptions (as some type of summative concept) are subject to these same individual influences because the organization's perceptions are a result of the perceptions of individual organization members (Downey and Slocum, 1975, p. 568).

In summary, although it seems reasonable that the organization's external environment, as an information environment, provides raw data that affect PEU, exactly how this occurs is not well understood. It also appears that organizational structures moderate whatever linkages exist between this information environment and PEU, probably by influencing the social processing of information (Daft and Huber, 1986). Finally, it appears that personal characteristics moderate these linkages, probably by influencing the cognitive processing of information.

Our discussions to this point have examined PEU primarily as a dependent variable. PEU has also been examined as an independent variable, as a determinant of organizational structures and processes. Of perhaps more general interest, information environments have also been examined as determinants of these critical organizational variables.

2.4 Effects of Perceptions of Information Environments and Uncertainty

Perceptions of external information environments, and in particular perceptions of external environmental uncertainty, are important because they influence the organizational choices that create the structures and process of the organizations in which we participate or which otherwise affect our lives.

We noted earlier Duncan's finding that external environmental characteristics are apparently related to PEU (Duncan, 1972). He also found that organizational units varied their decision making structures with their perceptions both of environmental uncertainty and of control over their

environment, and that this feature was more pronounced in the more effective organizations (Duncan, 1973; 1974). Thus perceptions of the external environment seem to affect decision structure and, perhaps in this way, they affect performance. In more recent studies, Leblebici and Salancik (1981) and Gordon and Narayan (1984) found that perceptions of the environment affect actual decision structures and processes, Bourgeois, McAllister, and Mitchell (1978) found that perceptions of uncertainty affect preferred decision structures, and Javidan (1984) found that PEU affected long-range planning practices in the savings and loan industry. Finally, but of considerable relevance given the subject of this handbook, Utterback (1985) found a positive correlation between externally-directed communications activity and PEU and interpreted this finding to mean that PEU affected communication.

The above discussion makes clear that perceptions of the information environment affect organizational structures and processes (also see Yasai-Ardekani, 1986). Now that the matter of these intra-organizational variables (structures and processes) is so conspicuously before us, it seems appropriate to examine the intra-organizational, or internal, information environment.

3. INTERNAL INFORMATION ENVIRONMENT

In this section we examine the relationships between an organization's information processing activities and its internal information environment.

In the early 1970's, three classic works established the perspective of organizations as information processing systems. James G. Miller devoted an entire issue of Behavioral Science, 182 pages, to portraying organizations as "living systems" made up of "matter-energy processing subsystems" and

"information processing subsystems" (Miller, 1972). Herbert Simon described in a convincing manner the need to design future organizations as if they were primarily information processing systems rather than goods and services-producing systems (Simon, 1971, 1973). Jay Galbraith synthesized disparate and diffuse research findings to set forth guidelines for designing organizations to process information (Galbraith, 1973; 1977). Related works are those by Thayer (1967), Wilensky (1967), Tushman and Nadler (1978), O'Reilly and Pondy (1980), and Huber (1982).

3.1 The Logistical and Interpretive Perspectives

The above works and the many like them tended to view information as having physical properties and to view organization information processing as a set of logistical activities. For example, even if the issue was one of trust between potential communicators, the focus concerned the distortion or nontransmission of information. We will refer to this view of information processing as the logistical perspective. In the 1980's a contrasting perspective on information processing appeared, one that focused on the meaning or interpretation of information rather than on the logistics of information (Daft and Lengel, 1983; Putnam and Pacanowsky, 1983; Daft and Weick, 1984). We will refer to this view of information processing as the interpretive perspective. Both perspectives view the organization itself as an information-laden environment. The logistical perspective causes information processing to be regarded as that which occurs when data is run through a pre-established interpreter to generate the answers to pre-established queries. Thus a particular inventory count (data) may be interpreted as "insufficient" to answer the question, "Should we order more material?" In contrast, the interpretive perspective causes information processing to be regarded as that which occurs during individual and

collective cogitation and reflection. Thus thousands of data elements, many of them drawn from long-term memory and the subconscious, are "mulled over" by individuals and discussed in small and large groups to crystallize individual perceptions and to create a shared meaning among group members.

For the purpose of discussion, we portray organizational information processing as being composed of three subprocesses: (1) information acquisition, (2) information-logistics activity, and (3) information interpretation.

3.2 Information Acquisition

Many of the formal activities that take place within or on behalf of organizations are forms of information acquisition, e.g., client surveys, inventory counts, research and development activities, and cost analyses. Many informal behaviors, too, are directed toward obtaining information, e.g., reading The Wall Street Journal or listening to coffee break "news." Acquisition of information, and the subsequent logistical and interpretive processes, are major organizational endeavors. The acquisition process and its results are important determinants of the internal information environment. In subsequent sections, we will explore the information acquisition of individuals. Here we examine the behavior of organizations and their components as they acquire information to learn about problems and opportunities and to fulfill information procurement and relay responsibilities.

Organizations sometimes learn of, and sometimes anticipate the arrival of, problems and opportunities. To deal with problems and opportunities, organizations seek out information. Their information acquisition behavior occurs in two forms, monitoring and probing. Organizations monitor their external and internal environments in order to identify problems and

opportunities (Aguilar, 1967; Hambrick, 1982; Stubbart, 1982). Monitoring or scanning is often routinized, as when sales people are required to report competitors' sales or car dealerships are required to report observed manufacturing defects. Organizations initiate ad hoc probes of their environments when more information is required than is available. These deeper examinations of the environment are responses to information or concerns about actual or suspected problems or opportunities.

Before a problem or opportunity will result in search, a number of conditions must be present. These conditions were recognized and succinctly articulated by early authorities. The major variable affecting the initiation of search is dissatisfaction--the organization will search for additional alternatives when the consequences of the present alternatives do not satisfy its goals (Feldman and Kanter, 1965, p. 622). There seems to be a general reluctance to initiate search unless it is clearly necessary.

Not until the element of novelty in a problem situation has become clearly explicit will a significant disruption of the relationship between the environment and the organism be sharply felt and a search begin for alternatives to the habitual response. Then and only then does a more or less conscious and deliberate decision-making process get initiated (Reitzel, 1958, p. 4).

Downs (1966, p. 190) suggested that for search-prompting signals to have an effect they must be very "loud" and received from multiple sources. More recently, Ansoff (1976) addressed this same point.

Apparently it is important not only that the need for problem-motivated search be clear, but that effort directed toward resolving the problem (or capitalizing on the opportunity) be viewed as having some probability of success (Glueck, 1976, p. 70; Schwab, Ungson, and Brown, 1985). For example, Kefalas and Schoderbek (1973) found that when an organizational unit perceives that some situation can be controlled in the future, then it

is more likely to initiate information search activities. In particular, they found that managers spent more time acquiring information about "relatively controllable sectors of the external environment than for the relatively uncontrollable sectors," (Kefalas and Schoderbek, 1973, p. 67). Of course not only must the search effort be viewed as having some probability of success, but it must be viewed as not excessively difficult (O'Reilly, 1982; Culnan, 1983).

Together these ideas suggest that some sort of threshold must be exceeded before search will take place, where the threshold is defined both in terms of the costs and payoffs associated with searching versus not searching and in terms of the probabilities that these costs and payoffs will be incurred. Mintzberg, Raisinghani, and Theoret (1976) discussed a search initiation threshold in terms of these variables, as part of their analysis of 25 instances of organizational problems solving.

In aggregate, the literature that addresses the topic suggests that problem-motivated search will be initiated (1) when a problem is recognized and (2) when some heuristic assessment of the costs, payoffs, and probabilities involved suggests that a search-justifying threshold value has been reached or exceeded. The classic A Behavioral Theory of the Firm (Cyert and March, 1963) suggested that these conditions are both necessary and sufficient for search to occur. Problem-motivated search will not be initiated unless they occur and will be initiated if they occur. In his revision and extension of the behavioral theory of the firm, Carter (1971) added the concept of internally-induced search, often a search for opportunities: "the procedure was for the president to initiate probes by mentioning, either in casual conversation or by explicit memorandum, that Comcor was interested in purchasing certain types of companies. Staff

members could then seek companies that fit the requirements" (Carter, 1971: 420).

Monitoring and probing activities aid organizations in carrying out the critical functions of decision making and control, and thus are determinants of organizational effectiveness (Proctor, 1978). They are also determinants of perceived environmental uncertainty (PEU). The relationship seems to be straightforward--if information is the antithesis of uncertainty, then monitoring and probing should reduce uncertainty by producing information. It is not so straightforward as it seems, however, because the information encountered may contradict current beliefs about the environment; it may increase uncertainty by introducing doubt. For example, an organization may "believe" that its sales will be 100,000,000 units and make hundreds of planning decisions accordingly. But if market monitoring identifies the fact that a new major competitor has entered the market in which the organization planned to sell these units, uncertainty is greatly increased. Clearly, information can increase uncertainty.

Although the information acquisition that is motivated by decision-related problems or opportunities has attracted the most attention, and has become conspicuous in the literature, a good deal of information acquisition takes place in order to fulfill information procurement and relay responsibilities. The idea that information sought only for the purpose of affecting decisions is

an overly simplistic view of the incentives for providing technical information to administrative agencies. . . . A number of other incentives . . . point to a perceived duty or responsibility to provide technical information without regard to probably instrumental effect on actual decisions (Sabatier, 1978, p. 404).

The U.S. Bureau of the Census acquires enormous amounts of information that is not used directly to solve its problems or exploit its opportunities. We must not overlook the fact that much information is acquired for reporting purposes, presumably to satisfy the decision making and control needs of other organizations or organizational units. This is especially true in the case of staff units such as accounting and market research.

Information acquisition is clearly a major determinant of the organization's internal information environment. Whether and how the information becomes interpreted is greatly affected by the logistics of the organization's internal information processing system.

3.3 Logistics of Internal Information Processing.⁴

Organizations purposefully acquire and internally disseminate information for the reasons noted above, and ultimately to carry out the pervasive and critical functions of decision making and control. In many cases, this requires the processing of a large number of information-conveying communications, which we will call "messages." On the other hand, because a large number of messages may cause an overload on the cognitive and logistical capabilities of the individuals and work groups involved, organizations are forced to seek efficiencies in their internal communication systems.

Two processes that organizations use to increase the efficiency of their communication systems are message routing and message summarizing. Message routing causes any particular communication or message to be distributed to relatively few organizational units, where the word "unit" is to be interpreted broadly and may refer, for example, to an individual, an ad hoc committee, a formal work group, or even a corporation division. This

selective distribution greatly reduces the information processing load of the many potential receiving units having little or no use for the information and of the many intermediate units involved in summarizing or transmitting the message. Message summarizing plays a similar role. It has as its purpose reducing the size of the message, while at the same time, faithfully reproducing its meaning. For example, large sets of numbers are replaced by their average and multi-page reports are replaced by appropriately derived recommendations or conclusions. Summarization can greatly reduce the cognitive or logistical load on the units having to process the message.

Messages vary considerably in relevance, length, accuracy, timeliness, and other attributes. As a consequence of this fact and the need to control their work load, the units responsible for routing and summarizing necessarily exercise some discretion in the way they handle messages. Such discretion allows two other information-processing phenomena to occur in parallel with summarizing and routing. These are message delay and message modification.

There is no value judgment or negativism implied in the use of the phrase message delay. Since the priority assignment given a message is a principal determinant of the time it will be delayed, and since making such assignments is necessarily (at least in part) a delegated and discretionary act, it would often be difficult to make objective judgments about the excessiveness of individual delays. Message modification refers to the distortion of message meaning. Its source may be either the cognitive limitations or the motivations of the sender or receiver. Modifications may be conscious or unconscious, well-intended or malicious. They range from the well-intended correction of minor errors to the extreme modification of

substituting one message for another. Message modification differs from message summarization in that it distorts a message's meaning, whereas summarization does not. Although these four processes are often portrayed as occurring in the context of a formal organization, they obviously occur in informal organizations as well.

Let us turn now to examining these logistical processes that in aggregate so greatly affect the organization's internal information environment. We begin with the processes of routing and delay which, because they determine the amount of information at any one place at any one time, determine the density of the internal information environment.

Density of the internal information environment. The literature identifies five variables that affect the routing and delaying of messages to a particular organizational unit, and hence that affect the density of the information environment of that unit: (1) message relevance and timelines; (2) workload of message-sending units; (3) difficulty of communicating to the message-receiving unit; (4) effect on potential sending units of the receiving unit's obtaining the information; and (5) the relative power and status of the sending and receiving units. The literature pertaining to these variables is voluminous. We summarize it here in just five paragraphs, as our purpose is not to review the literature on organizational communications, but rather to identify the determinants of the density of the internal information environment.

Organizations tend to reward activity that achieves organizational goals and to punish activity that does not. It follows that message-sending units, in order to achieve organizational rewards and avoid organizational penalties, would use the relevance of a message for some other unit as criteria in determining whether to route the message to that unit.

Relevance is, of course, influenced by assigned tasks and responsibilities. For example, Tushman (1979) found that, for high performing units, the greater the task interdependence between units, the greater was the frequency of communication routed between the units. With regard to delay, Huber and Ullman (1973) and Gerstenfeld and Berger (1980) found that message-sending units tended to delay their messages when premature delivery would reduce the message's impact. In summary, units whose task fulfillment is viewed as more likely with information held by other units will have this information directed to them and consequently will encounter a higher density information environment.

It is reasonable to expect that the information transmission behavior of organizational units would be affected by their workload. Meier, for example, found that overloaded units "destroy lowest priorities" when carrying out their functions (Meier, 1963), thus precluding any routing at all. With regard to delay, Downs found that "The most common bureau response to communications overloads is slowing down the speed of handling messages" (Downs, 1966: 270). Research identifying similar behaviors by smaller units, i.e., individuals and small groups, is reported by Miller (1960) and Driver and Steufert (1969), respectively. Thus the density of a particular unit's information environment is determined in part by the workloads of the units most likely to send messages to that unit.

In order to conserve their resources, organizational units tend to communicate more frequently with units easily contacted than with other units. This common-sensical statement is a special case of a cross-level hypothesis applicable to all living systems: "In general the farther components of a system are from one another and the longer the channels between them are, the less is the rate of information flow among them" and

"the less . . . encoding a channel requires, the more it is used" (Miller, 1972. p. 3). Empirical studies such as those by Brenner and Sigband (1973), Conrath (1973), and Bacharach and Aiken (1977), have found that either physical or structural accessibility is a determinant of the frequency with which subordinates communicated with superiors. The difficulty in communication may be interpersonal as well as physical or structural, as observed by Brenner and Sigband (1973), and Goldhar, Bragaw, and Schwartz (1976) and Jain (1973). Thus the density of the information environment at any unit is partly a function of the perceived difficulty of communicating to the unit.

The social-psychological research dealing with the suppression of "bad news" in interpersonal communications reminds us that messages are suppressed if their transmission is likely to result in the receiver doing harm to the sender (cf. Read, 1962; Rosen, Johnson, Johnson, and Tesser, (1973); and McCleary, (1977). Similarly, the research on bargaining (cf., Cummings and Harnett, (1980) and organization power (cf., Pfeffer, 1980) indicates that information is a critical resource in joint decision situations and that withholding information from one's competitors is often useful in attaining one's goals in a competitive environment. Thus the amount of information received by a unit is a function of the likelihood that the potential senders will incur no harm from the unit as a consequence of providing the information.

Early researchers concluded that (1) persons of low status and power tend to direct messages to persons with more status and power, and (2) persons of high status and power tend to communicate more with their peers than with persons of lower status and power (Barnlund and Harland, 1963; Collins and Guetzkow, 1964, p. 187; Allen and Cohen, 1969). The conclusion

might also be inferred from the early finding that persons in high organizational positions, positions which often have more power and status, are better informed (Davis, 1953; Zajonc and Wolfe, 1966; Sutton and Porter, 1968), although other variables such as seniority or perceptiveness may also play a role in this finding. Some nonsupportive evidence is the conclusion of Davis (1953), in his study of communications within an industrial management group, that "the predominant communication flow was downward or horizontal." It seems, however, that this finding might be a consequence of (1) higher organizational levels issuing directives that were in reality initiated by lower level staff groups or (2) the fact that in organizations with routinized technologies many upward "messages" are uncoun-tered by observers, e.g., scheduled quality control reports or the absence of "out-of-stock" reports which is, via management by exception, a message in itself. The preponderance of evidence suggests that the density of the information environment (attributable to communications) is greater for high status persons or units. The literature on the personal information environments, examined in section 4, supports this conclusion.

Together routing and delaying determine the density of the organization's internal information environment. The next two processes to be examined, summarizing and modifying, determine the form of messages and thus determine the interpretability of the information contained in the messages.

Interpretability of the internal information environment. Message summarization reduces the information logistics load on organizational units, and thereby reduces the perceived density of the information environment. However, even though it is a process purposefully employed by organizations and tends to have as an outcome a faithful representation of

the original content, summarization may increase the ambiguity of the information environment, if the retained content is equivocal, if the summarization reduces the richness of the message and hence some of its interpretability and meaning. "Language is a carrier not only of information but also of meanings" (Pettigrew, 1977: 85). We will pursue this idea further in our later discussion of information interpretation.

There is very little empirical literature that deals with message summarizing, perhaps because findings of successful summarization, i.e., condensation without distortion, are less titillating than are findings of modification, e.g., alteration with distortion. There is, in contrast, a sizable literature that deals with message modification. We will summarize it in just a few paragraphs in order to highlight the effect of modification on the interpretability of the information conveyed in the messages, i.e., on the interpretability of the internal information environment. We begin with a discussion of the motivational bases for modification, then turn to those dealing with perceptual and cognitive bases, and conclude with a discussion of an organizational determinant of message modification.

Motivational bases. As a result of his extensive interviews with administrators, Downs concluded that "Each official tends to distort the information he passes upward in the hierarchy, exaggerating this data favorable to himself and minimizing those data unfavorable to himself" (Downs, 1966: 266). His conclusion is strongly supported by laboratory studies (c.f., Cohen, 1958; O'Reilly and Roberts, 1974) and field studies (c.f., Gore, 1956; Read, 1962; Athanassiades, 1973; Kaufman, 1973; Roberts and O'Reilly, 1974; and O'Reilly, 1978). The dependent variables in these studies were quite varied and included revising the message format (the mildest form of modification) and eliminating the message or substituting an

incorrect message (the more extreme forms of modification). Related findings are that when senders do not trust the motives of the receivers, they tend to modify the messages more than otherwise and that modification is influenced by the sender's perception of the receiver's influence over the receiver and the sender's mobility aspirations (Mellinger, 1945; Roberts and O'Reilly, 1974). O'Reilly (1978) provides a particularly articulate discussion of the variables of trust, influence, and mobility. Altogether such findings make clear that the congruence between the actual external or internal environment and a person's or unit's information about that environment is a consequence of the messages that create the internal information environment, and that the content of these messages is a function of the goal attainment that message sending units believe will accrue to them if they distort message content.

Some research suggests that message modifications are made for the purpose of reducing the stress on the receiver. In his review of the early psychological research, Campbell noted that "through an anticipatory monitoring of his own intended output, he (the sender) makes an active effort to produce a coherent output, by suppressing remembered detail that does not now seem to fit and by confabulating detail where gaps are conspicuous" (Campbell, 1958: 342). Further, Rosen and Tesser (1970) found, even after controlling for any possible prior or subsequent interaction between the sender and receiver and for the possibility of any punitive action being taken by the receiver against the sender, that senders still attempted to modify their messages so as to not distress the receiver. As a result of his reading of the literature, Ference stated that "information, once evaluated and integrated, will tend to fit the transmitter's perceptions of the recipient's needs" (Ference, 1970: B-85). Thus as

message senders perceive the receiving unit to be stressed, the interpretability of the information environment is increased, but its representativeness (of the actual environment) is decreased.

We turn now to the perceptual and cognitive bases of message modifications. While they and the motivational bases of message modification are intertwined--what we perceive is affected by what we are and what we are is affected by what we perceive--it seems useful to make distinctions between them where possible.

Perceptual and cognitive bases. The fact that message senders are often themselves receivers of the messages that they transmit has some interesting implications. In his review, Campbell (1958) noted that both cognitive limitations and personal motivations cause transmitters to imperfectly modify messages during their own assimilation, stating that the "tendency to distort messages in the direction of identity with previous inputs is probably the most pervasive of the systematic biases" (p. 346), and "that . . . the human transmitter is prone to bias away from input in the direction of the transmitter's own attitudes" (p. 350). These conclusions suggest that information inputs are transformed in the direction of the receiver's prior information, expectations, or wishes. Porter and Roberts, in their review of findings related solely to cognitively based transformations, stated that "These results would indicate that the more tangible and objective the subject matter . . . the more likely it is that subordinates and their superior will feel that they are communicating accurately, whereas when the messages involve more subjective opinions and feelings there is greater doubt about accuracy" (Porter and Roberts, 1976).

It seems reasonable to believe that, if the sender is either cognitively or logistically overloaded, message modifications would be

greater. "Whenever human beings operate at near maximum capacity, selective information loss--undesired reduction of message complexity--is apt to be involved . . ." (Campbell, 1958: 336). Additional support is given to this idea by the case study by Meier (1963), and the review by Driver and Streufert (1969). The net effect of these limitations of message transmitting units is that the congruence between the actual environment and the person's or unit's information environment is a consequence of the ambiguity of the messages received by those who create the information environment and by the ability of these latter persons or units to deal with this ambiguity.

Organizational structure. As is well known, the probability and extent of any communication phenomena, such as message delay or distortion is greater the greater the organizational distance between the message's originating source and the message's ultimate receiver. A dramatic example of this is the following:

A reporter was present at a hamlet burned down by the U.S. Army's 1st Air Cavalry Division in 1967. Investigation showed that the order from the division headquarters to the brigade was: "On no occasion must hamlets be burned down."

The brigade radioed the battalion: "Do not burn down any hamlets unless you are absolutely convinced that the Viet Cong are in them."

The battalion radioed the infantry company at the scene: "If you think there are any Viet Cong in the hamlet, burn it down."

The company commander ordered his troops: "Burn down that hamlet" (Miller, 1972: 69).

In this section we have examined how the logistics of organizational information processing affect the density and interpretability of the internal information environment. In the next section we will address the relationship between information environments and information interpretation.

3.4 Information Interpretation.⁵

We noted earlier that information can both increase and decrease the uncertainty associated with pre-established questions or assumptions. But how does information lead to understanding? How does it get interpreted? Our answer lies in two ideas: (1) human beings not only receive information but also give meaning to its content, they interpret it, and (2) this interpretation is affected by communications from other individuals, that within organizations shared meanings develop through interaction. These ideas have their roots in symbolic interactionism and are closely linked to concepts of communication media.

Symbolic Interactionism. The internal information environment can be understood within the broad theoretical framework suggested by symbolic interactionism (Stryker and Statham, 1985). In the imagery of symbolic interactionism, the organization is conceptualized as a dynamic web of communications. Over time, and through the interaction of organizational members, symbols evolve and take on meaning. Symbols provide meaning that can be used to interpret situations and adjust behavior. Thus an adherent of this framework would argue that organizations are comprised of people interpreting situations and the actions of people based on those interpretations (Blumer, 1962) and, further, that because even established and repetitive forms of action must be renewed through interpretation and designation, organizations are fluid and are continuously constructed and reconstructed via definitional and interpretive processes (Blumer, 1962; Haberstroh, 1965: 1201).

The basis for interaction among organization members is a shared system of meaning. With respect to organizational information, this symbolic

interactionism framework focuses on the underlying purpose and meaning of messages. Research into communication environments from this perspective is concerned with organizational symbols and their meanings, and how individuals create and interpret those symbols (Putnam, 1983). Specific research concerns are the cognitive interpretation of messages, the means through which shared interpretations are reached, and the media through which messages are transmitted.

The concept of information equivocality is central to understanding the value of symbolic interactionism. Without shared meaning, behavior in organizations would be disorganized and random. Problems arise when the meaning of the situation or problem is not shared or is ambiguous, when individuals are unclear about what an event means or how to translate it into organizational action, when previously shared definitions are unsuited to a situation. In these cases, meaning is created through social interaction and discussion, primarily through language and other social cues. Shared meaning requires development and use of a common language for resolving ambiguity. When confronted with equivocal information, managers use language to share interpretations among themselves and gradually define or create meaning through discussion, groping, trial and error, and sounding out. Managers organize cues and messages into reasonable patterns by imposing meaning through their interpretations (Weick, 1979b; Smircich, 1983).

When viewed with this framework, the contrast between symbolic interactionism and the straightforward information acquisition and transmission described in the previous section becomes clear. Where situations are routine or well understood, with a history of common interpretation, information acquisition and transmission are sufficient to

make organizational choices that solve problems or exploit opportunities. However, novel and unexpected events cannot be handled in the same way, because existing meanings are inadequate to interpret the information received. When the equivocality of the information environment is high, the problem for managers is to interpret and know the world. The symbolic interactionism view would hold that the essence of managerial action is the reduction of equivocality through the establishment of a shared perspective so that appropriate behavior can be defined and established within the organization's regular structure and processes.

Media richness. How can information environments be designed to facilitate reduction of varying degrees of equivocality in organizations? One answer is to vary the media used for communication. Organizations process information through many channels, including face-to-face conversations, electronic mail, the telephone, and memos. Recent research makes clear that these channels are not equal in their capacity for reducing equivocality. Daft and Lengel (1984) proposed that media selection is closely linked to the amount of equivocality in the environment of managers. Based on the work of Bodensteiner (1970), Daft and Lengel proposed that media used in organizations can be organized into a richness hierarchy, where richness is the medium's capacity to change understanding through conveying information (Lengel, 1983; Daft and Lengel, 1986). Face-to-face interaction is the richest medium, followed by telephone, personally addressed documents, and formal, unaddressed documents. The information capacity of these media is a function of four features: (1) the opportunity for timely feedback; (2) the ability to convey multiple cues; (3) the tailoring of messages to personal circumstances; and (4) language variety.

Face-to-face discussion is considered the richest medium because it allows immediate feedback so that understanding can be checked and interpretations corrected. This medium also allows the simultaneous communication of multiple cues, such as body language, blush, facial expression, and tone of voice, cues which convey information beyond the spoken message that enhance understanding of the message beyond its information content (Meherabian, 1971). Face-to-face communications also use high variety, natural language, and messages are tailored personally to the receiver (Daft and Wiginton, 1980). The telephone medium is less rich than face-to-face interaction because visual cues are screened out. Feedback is fast, however, so individuals may be able to resolve equivocality. The telephone medium is personal and utilizes natural language, but relies on only language content and audio cues rather than visual cues to reach understanding.

Written communications are typically lower in richness than oral communications. Personally addressed documents, such as letters and memos, are characterized by slow feedback compared to face-to-face and telephone conversations. Only written information is conveyed so visual cues are limited to those on paper, although addressed documents can be tailored to the individual recipient. Formal, unaddressed documents are lowest in richness. Examples are fliers, bulletins, rules, and computer reports. These documents are impersonal, are not amenable to feedback, and visual cues are limited to those in the standard format.

The information environment within organizations must allow symbolic interactions that fit the level of equivocality. In order to develop understanding when events are equivocal, a rich medium is needed. However, when events are well understood and meaning is already shared, then a medium

of low richness can convey objective message content well enough that the appropriate role behavior can be elicited.

Hierarchical level and media richness. The information environments within all organizations contain a mix of the well-defined and the ambiguous, the routine and the nonroutine. The events in the information environment differ by hierarchical level. At the top of the organization, the manager's world tends to be ambiguous. Most problems are fuzzy, complex, and poorly understood. Top managers decide goals and strategy, and influence internal culture. Top managers create and maintain a shared belief and interpretation system among themselves. They have few objective facts. They must confront equivocality, make sense of it, and attempt to communicate order and meaning to lower levels of the organization. The information environment of top managers puts them in the situation of shaping reality for the rest of the organization. Managers use combinations of symbols, metaphors, speeches and body language to communicate values, goals, and culture throughout the organization.

The information environment at lower organizational levels is typically less ambiguous. The need to reduce equivocality is minimal. The information processing task is more objective. Employees and first-line supervisors can make use of traditional meanings. Experience, policies, rules and regulations, formal authority, and the physical requirements of technology govern their activities. Since events are well defined, employees at lower levels can work within the plans, goals, culture and technology defined at higher levels.

The information environment thus varies by hierarchical level, with a larger proportion of equivocal cues at the top, and a higher proportion of unequivocal cues at the bottom. Top managers establish a common grammar and

shared meaning system to be passed down the hierarchy. Middle management works within a somewhat better defined symbolic structure than top management, although some discussion and interpretation will take place. At lower hierarchical levels, such as within the technical core, information cues and events can be interpreted within established meanings and frames of reference. The organizational hierarchy in this sense is a mechanism for equivocality reduction. Organizations develop meaning systems at the top of the organization to reduce uncertainty in the information environment at lower levels. Top managers use rich media to discuss, analyze and interpret events and to develop goals and strategies. These interpretations are translated into less rich policies, paperwork, instructions, rules and procedures for use at middle and lower organizational levels. Organizations thus create meaning systems and reduce equivocality through the use of sequentially less rich media down the hierarchy. Employees at lower organizational levels are given a sense of specific roles, tasks, and purpose and are able to perform efficiently without having to interpret and define messy, equivocal issues.

When organizations adapt to external changes, or when top managers develop new interpretations, the new meanings trickle down through the organization in the form of new technologies, products, procedures, and reports. Top managers, to be effective, must learn to confront equivocality and to convey appropriate values and meanings to others in the organization through rites and ceremonies, stories, symbols, and slogans. As Karl Weick (1979) expressed it, "Managerial work can be viewed as managing myth, symbols, and labels . . . because managers traffic so often in images, the appropriate role for the manager may be the evangelist rather than the accountant."

Computer-based communications media and message interpretation.

Computer-based communication technologies have the potential to bring about major changes in the internal information environments of organizations. The introduction of mainframe computers, personal computers and office automation have changed organization structure (Whisler, 1973; Carter, 1984; Daft, 1986). However, new forms of electronic communication networks, including electronic mail, automatic file sending, computer teleconferencing, and electronic bulletin boards have the potential to drastically alter the symbols and interpretive processes within organizations.

Research by Kiesler and Sproull (Kiesler, 1986; Sproull and Kiesler, forthcoming) has begun to determine how such electronic technology shapes the social and interpretive processes within organizations. The networking of managers through electronic mail, for example, increases the volume and speed of data transfer, but also has several important and not readily anticipated social effects. First, few social cues are conveyed with messages. The receiver learns little about the social context of the sender, such as social or organizational position. Messages are limited to bare facts because there is little opportunity to influence the tone, mood, or importance of the message through the computer medium. Immediate feedback is not available to allow the sender to modify the message to be congruent with receiver expectations.

A second effect that influences interpretation is a greater sense of anonymity. People feel less connected to others in the communication network. They interpret messages with less empathy and do not feel or respond to norms to the same extent. A third effect is the reduction of incentives to reflect on messages. Without hard copy, communications are

communicated quickly, and are interpreted in a superficial way. Weick (1986) argued that people make sense of complex events through slow and careful reasoning. Deliberation takes time, and speed of computer mediated communication may mitigate against thoughtful interpretations. On the other hand, its timeliness may lead to more informed interpretations. Both of these conjectures, and their interaction, require empirical study.

A fourth issue pertains to the development of new groups and affiliations within organizations. A computer user's relevant others are people in the computer network rather than colleagues in the same office area or that work on the same tasks. Norms, to the extent they do arise, will be based upon new groupings that frequently span organizational boundaries. Groups cut across traditional boundaries and are constructed around topics about which they have to communicate rather than around the tasks they are performing.

These changes in the information environment may impair interpretation processes. To the extent that the internal information environment is unequivocal, computer mediated communication may pose few problems. But when the organization experiences incidents of uncertainty and ambiguity and equivocality rises, then computer mediated communications may filter away important cues. Weick (1986) argued that managers need noncomputer data to interpret their world. Computer mediated information does not facilitate the symbolic interaction needed to cope with equivocal environments. As contrasted with face-to-face or even telephone communications, when communicating through computers people are less able to use trial and error and feedback about the interpretation of events, are less able to draw upon diverse cues from multiple channels, and do not have cues from the larger social context to form a sensible interpretation.

The full impact of computer mediated communication on internal environments has yet to be determined, as organizations are just now adopting the technology. The technology has great potential for facilitating the logistical aspects of internal information processing, but there may be important adverse effects on symbolic interaction, and hence on information interpretation. If use of computer mediated communication inhibits interpretation, then managers may be forced to work around the technology to make sense of equivocal environments. This may mean combining use of the electronic media with media capable of conveying "richer" messages, such as face-to-face meetings supported by Group Decision Support Systems (Huber, 1984b). For additional insights into the usefulness or uselessness of computing technology as a communication medium, see Power (1984), Zmud (1986), and Culnan and Markus (forthcoming).⁶

4. PERSONAL INFORMATION ENVIRONMENTS

Individual organizational members both select and have imposed on them different information environments. To a great extent, both their actual information environments and their perceived environments are the consequence of organizational communications. Our goal in this section is to review the nature of the personal information environments of organizational members and the role of organizational communication in establishing these environments. We will focus on the information environments of managers, because (1) managers have an extremely rich and varied personal information environment, and (2) more research has been conducted on the work environment and behavior of managers than on that of any other occupation. We begin in Section 4.1 with a review of the nature of managerial work and the resultant information environment. In Section

4.2 we discuss information acquisition and overload in the context of managerial work.

4.1 Managerial Work and Information Environments

Rosemary Stewart's (1982) "Model for Understanding Managerial Jobs and Behavior" sharpens the notion that managers both choose and have imposed upon them an information environment. The nature of this information environment is inextricably linked to and determined by the nature of managerial work, a subject about which much has been written and which necessarily sets the stage for any examination of the manager's information environment.

Early conceptualizations of managerial work were contributed by the classical management theorists based on their personal observations and discussions with peers. For example, Fayol (1916/49), and Gulick (1937) set forth and discussed "management functions" such as "planning" and "coordinating." Taxonomies of managerial functions guided early empirical work. For example, Mahoney, Jerdee, and Carroll (1965) surveyed managers on the amount of time they spent each day on the functions of planning, investigating, coordinating, evaluating, supervising, staffing, negotiating, and representing. Gradually empirical studies began to classify managerial work more by the behaviors of managers rather than by the functions that these behaviors were intended to fulfill, although the distinction was not (and is not) always clear. Early reviews of the literature are those by Nealey and Fiedler (1968), Campbell, Dunnette, Lawler, and Weick (1970) and Mintzberg (1973).

Mintzberg's (1973) observational study gave added impetus to the study of managerial work in two ways. One was that he grouped the behaviors he observed into a taxonomy of managerial "roles", such as "liaison",

"monitor", and "entrepreneur", rather than the more traditional management functions.⁷ The second was that the findings were published in the Harvard Business Review (Mintzberg, 1975) in the form of an antithesis to the view that managers engaged themselves in carrying out the management functions set forth by the classical management theorist. This article struck a responsive chord among managers and was awarded the McKinsey Prize for the best management article of the year.

A number of empirical studies appearing in the organizational behavior literature have used Mintzberg's work as a point of departure (c.f., Allan, 1981; Paolillo, 1981; Kurke and Aldrich, 1983). Kurke and Aldrich concluded from their observational study that their "replication of Mintzberg's (1973) decade-old study confirms the soundness of his results, reinforcing the image of managers as operating in a work setting characterized by fragmentation, brevity, concentration on live media, and dependence on others for initiating contacts" (Kurke and Aldrich, 1983: 983). This statement suggests that the manager's information environment is dense and turbulent. It also suggests that the information environment is interpreted more through work-related social interaction than through individual cogitation and reflection. As characterized by Mintzberg and those replicating his findings, managers "are strongly oriented to action and dislike reflective activities" (Mintzberg, 1976: 50).

Recent survey studies have examined differences in the activities and roles of managers holding positions at different organizational levels and in different functional areas. Tornow and Pinto (1976) used factor analysis to identify thirteen "position description factors", and found that the factors loaded quite differently on jobs at different levels and in

different functional areas. In particular, top management jobs loaded much higher, relative to five other managerial job types, on "strategy planning" and "responsibility for human resources and the policies affecting it" (Tornow and Pinto, 1976: 414). Allan (1981) classified the managerial activities reported to him into tasks and found 57 to be common across entry, middle, and upper levels managers, but a like number to be carried out uniquely by the different levels. Paolillo's (1981) and Pavett and Lau's (1983) surveys focused on the perceived importance of Mintzberg's ten managerial roles and found that it varied across three managerial levels. Sproull focused on the attention, rather than functions or roles, of state agency managers and school managers and found that "agency managers attend more to internal details . . . while school managers attend more to outside requests and social pleasantries" (Sproull, 1984: 18). All of these studies seemed to confirm Mintzberg's conclusion that managerial work is characterized by brevity, variety, and fragmentation, and consequently confirm the idea that the information environment of managers is dense and turbulent, although there is some indication that at the upper levels the load is more controllable.

Other studies have led to conclusions not so compatible with Mintzberg's. Stewart (1976) showed that Mintzberg's conclusion about the nature of managerial work is not true of all managerial jobs and Marshall and Stewart (1981) and Stewart, Smith, Blake, and Wingate (1980) found that in some jobs Mintzberg's characterization of managerial work is a chosen outcome, as some managers choose to adopt a different work environment. Stewart emphasized the job content flexibility that managers have or develop and that "the need is to move on from Mintzberg's (1973) roles and propositions about managerial work to an analysis that takes into account

the variations in behavior and the differences in jobs before attempting to generalize about managerial work" (Stewart, 1982). Thus while Mintzberg's successors (Allan, 1981; Paolillo, 1981; and Pavett and Lau, 1983) found work environment variations across levels and functional areas, Stewart found variations created by individual managers. It seems worthwhile to note that Mintzberg and Sproull used an observational methodology, while most of his successors used surveys, and Stewart used interviews.

Snyder and Glueck argued that Mintzberg's inability to identify planning as a significant component of managerial work was a consequence of the fact "that by viewing the (observed) managerial activities as discrete events and not attempting to relate them one to another, Mintzberg did not grasp the importance of or the purpose for the activities he observed" (Snyder and Glueck, 1980: 70-76). They supplemented their weeklong observations of the work of two executives by asking each executive to explain what he was doing and why he was doing it each time he engaged in an activity. "The major finding of this research is that while the planning activities in which managers engage could appear to be unrelated at first glance, many of them are related because they are part of a program being planned by the manager. In effect, Mintzberg is not seeing the forest, only hundreds of individual trees" (Snyder and Glueck, 1980: 75).

Although much more empirical work needs to be done, in aggregate the studies subsequent to Mintzberg's (1973) study suggest that, at least for some individuals or at higher-level positions, the brevity, variety, and fragmentary nature of managerial work, and hence the density and perhaps the interpretability of the personal information environment, can be controlled. In addition, the work of Snyder and Glueck (1980) suggests that the manager's personal information environment may not be as fragmentary as it

appears, but rather that it is chunkable (c.f., Newell and Simon, 1972: 792; Simon, 1974) or mapable into a plan. If this is so, the effective load associated with a manager's information environment may not be as great as it appears.

4.2 Information Acquisition and Overload

In section 3.2 we examined the information acquisition behavior of organizations and their components. We noted there that (1) search for information is undertaken to learn about problems and opportunities and how to deal with such, and (2) search for information is undertaken to carry out assigned tasks. Individual organizational members are the organizational "components" that operationally carry out these searches, and much of what we presented in section 3.2 applies in this section on the information environments of individuals as well. Especially we note that the information acquisition behavior of individual upper-level managers seems to be in accord with the organizational information acquisition needs noted in Section 3.2. For example, Kefalas and Schoderbek (1973) found that upper-level executives devoted more time to information gathering in the environment than executives in lower levels. In addition executives in more uncertain environments spent more time acquiring external information than did executives in a stable environment. These data are corroborated by Aiken and Hage who found that boundary spanners tended "to be higher in the chain of command" (1972: 29). Three additional issues, however, beyond those discussed in 3.2, seem worthy of attention: (1) the rationality of search, (2) information acquisition unrelated to a focal problem, and (3) information overload.

Rationality in problem-motivated search. To a great extent, individuals construct their personal information environments. Some of this

construction is subconscious or unintentional, for example, selectively perceiving the actual environment so that the resulting information environment is biased (c.f., Dearborn and Simon, 1958). Some of it is decidedly intentional, however, the conspicuous and important example being problem-motivated search for information.

Officials increase the intensity of their search efforts above the normal "constant scan" level whenever their performance falls below the satisfactory level, or their normal search reveals some opportunity to significantly improve that performance (Downs, 1966, p. 272);

Is such problem-motivated search carried out rationally?

The implied answer to this question is generally held to be "no!" For example, a variety of laboratory studies have documented the tendency of decision makers to seek more information than required (see the review in O'Reilly, 1980). And while some laboratory studies have found performance to increase with sought-out information, others have found it to decrease at high loads--leaving open the possibility that the decision makers were not rational in that, even though they had the opportunity to discontinue search and prevent information overload, they chose to continue their search beyond what was functional (see the review in O'Reilly, 1980, and also Shields, 1983). On the other hand, the managers of the problem-solving organizations described in Chapter 4 of A Behavioral Theory of the Firm (Cyert and March, 1963) are portrayed as engaging in insufficient search to properly solve the problem before them. What explanations are there for these apparently irrational search behaviors?

With respect to the findings of excessive information acquisition, we offer three thoughts. First is the idea that those who conduct laboratory studies of information acquisition generally compute the costs and payoffs in the same units, e.g., dollars, ignoring the potential psychological

payoff to the experimental subject of knowing that he or she has "solved the problem." Since it is almost certain that experimental subjects would assign at least some positive subjective value to succeeding at the task, over and above the extrinsic payoff from the experimenter, and would rationally "pay" the search costs to obtain this subjective payoff, the experimenters' computation of the appropriate degree of search is generally too conservative.

The second explanation for the apparently excessive search effort is the need to reduce cognitive dissonance, a need documented in the field as well as the laboratory (Festinger, 1964; Vroom, 1966; Soelberg, 1967). Seeking additional information to reduce dissonance by confirming a decision already made (perhaps made with an optimal degree of search) will result in psychological payoffs if the seeker believes that the additional information will be confirming. Life experiences make this a reasonable belief for two reasons. (1) Many decisions have been correct, and on average the post-choice data would be confirming of correct decisions. Our subconsciously selective recall of confirming instances makes this seem even more true than it is, thus favoring the belief that confirmation will occur. (2) Selective perception in the past has caused the frequency of instances where additional post-choice data were seen as confirming to be high, thus again favoring the belief that confirmation will occur and that psychological value will result from post-decisional "search."

In the context of ongoing organizations, Feldman and March (1981) offer a third explanation for information acquisition that is apparently not cost effective. They note that those who command that the information be obtained (e.g., line managers) often do not incur the search cost--the search is conducted by staff units. Our own observation is that staff units

are only too glad to take on the task, as it justifies their existence and legitimizes requests for increased resources.

In contrast to the matter of apparently excessive search, what explanations are there for the apparently inappropriately low level of search observed in the case studies reported by Cyert and March (1963)? One explanation is the idea of cognitive limitations developed so articulately in March and Simon (1958) and Newell and Simon (1972), the idea that decision makers knowing they cannot effectively process additional information choose to use simple decision rules such as choosing the first-found alternative that meets the minimum constraints. While not denying the merits or importance of this explanation, we note that organizational participants, particularly managers, have available considerably more information processing resources than do unsupported individuals, resources such as staffs, computers, organizational memories, and experienced peers and superordinates. Rather than innate cognitive limitations, we believe that the apparently less than appropriate level of search is at least as well explained by (1) the psychological cost associated with the tension of an unsolved problem and (2) the real costs of not attending to the other competing demands.

Another form of apparently less than totally rational search behavior is the propensity for individuals to seek more accessible information rather than higher quality information (O'Reilly, 1982; Culnan, 1983). This behavior, too, can be at least partly explained by the need to save time and effort in one task (seeking information) so that other tasks may be attended.

Although only minimally explored in the literature, in many instances individuals seek out and acquire information even when they are not solving

or anticipating a specific problem. Whether this is rational is a matter of how broadly one defines rational. Two organizational realities drive this tendency to create a denser or richer information environment. One of these is politics; the other is preparation.

Information acquisition unrelated to a focal problem. In many situations, there are differences of opinion among the parties involved about which is the best course of action to follow. When this occurs, it often results in the search for information that will persuade the dissident party or the arbitrator to accept the proposed solution and perhaps to cooperate in its implementation (c.f., Patchen, 1974, p. 206, and Sabatier, 1978, p. 400). Some of this information may be closely related to the focal problem. For example, it may concern the nature of the dissident's preferences for the alternative solutions, as contrasted with the preferences that the primary decision maker thought were operating (see Balke, Hammond and Meyer, 1973, for an excellent example of the need for and possible use of such information). On the other hand, some of the sought-after information may be quite unrelated to the focal problem. For example, it may concern the nature of the side payments or threats that may be useful for gaining cooperation. In organizational settings, decision makers must frequently legitimate decisions to others. Sabatier (1978) discusses this point at some length and notes a number of field studies of organizational decision making in which information was sought for the explicit purpose of legitimating decisions reached on other grounds. The need to legitimate decisions to others often causes organizational members to search for more information than is necessary to solve the focal problem. This fact may be a partial explanation for the oft-repeated observation that decision makers acquire "too much" information (O'Reilly and Pondy, 1979; Connolly, 1980).

Organizational members seek information not only to fulfill explicit organizational requirements, such as solving problems or fulfilling assigned tasks, and to deal with organizational politics, but also to fulfill the felt need to develop personal information banks. Some of the search for information observed in organizational settings is undertaken by individuals seeking to develop or maintain a better understanding of their work environments. Example behaviors include reading company newsletters or technical journals and attending conventions or industry "shows." For some people, e.g., research personnel, this may be a major time-consuming behavior.

While the information thus obtained may result in the eventual fulfillment of organizational goals, it is obtained for the collector himself, or herself, rather than for the direct use of other units. For example, many officials regularly scan certain data sources (such as The Wall Street Journal or Aviation Week) without any prior idea of exactly what type of information they are seeking or will find. They do this not because they are dissatisfied, but because past experience teaches them that new developments are constantly occurring that might affect their present level of satisfaction (Downs, 1966, p. 169).

A related idea is that:

It is not always clear what information will be needed or when it might be useful. Hence, the nature of the job might require incumbents to gather large amounts of information with the possibility that a portion of it might be useful at some future time. This may result in an effort to ask for more information than is strictly needed in an effort to avoid mistakes and reduce uncertainty (O'Reilly, 1980: 692).

It may be that organizational members develop information banks in order to increase their influence or power. Certainly the literature suggests that there is a strong association between physical control over information and power or influence (Mechanic, 1962; Pettigrew, 1973; Spekman, 1979; Jamison, 1979) and also between uncertainty absorption and power (Ritti and Goldner, 1967; Hickson, Hinings, Lee, Schneck, and Pennings, 1971). On the other hand, intuitively appealing as the idea may

be, there seems to be little or no empirical evidence that organizational members or units search for information in order to acquire power without respect to a particular decision situation (but see Rein and White, 1977).

Information overload. At the outset we must distinguish between information overload and work overload. We define information overload as the condition where the amount of data that a person must process within a given time interval is more than the person can process within that time interval. Information overload is only one component of a manager's total workload. For example, of Mintzberg's ten managerial roles, only the monitor, disturbance handler, resource allocator, and negotiator roles would be likely to impose heavy information processing loads. Further, with regard to the latter three roles, the workload is often more a matter of acquiring information rather than processing it; there are decision routines and scripts in place that generate decisions whenever the required information becomes available. Thus, while managers may encounter work overload and even decision making overload, these facts do not mean that managers encounter information overload.

If a manager had an extremely dense or equivocal information environment, would he or she suffer the performance decrements generally associated with information overload? The answer to this question is, of course, affirmative, since all living systems suffer performance decrements if the environmentally imposed information processing requirements are sufficiently great (Driver and Streufert, 1969; Miller, 1978). Having this question and its answer out of the way sharpens the thrust of the next question.

Are the information environments of managers so dense or equivocal that performance decrements are typical? There are three reasons for our

qualified "no" to this question. One is that the work of Mintzberg (1975), Kurke and Aldrich (198x), and Stewart, Smith, Blake, and Wingate (1980) makes clear that managers control the density of their information environment to a considerable extent. While the information environments are very dense, it seems they are so because the managers seek out the information that makes them so, and we assume that managers generally avoid acquiring information at such a rate that it is debilitating (but see O'Reilly's speculation to the contrary, 1980, p. 686).

A second reason we believe information overload to be atypical is that managers have a variety of human resources for reducing the equivocality of their information environments. Staffs, peers, and superordinates are plentiful and we believe are used with great frequency to aid managers in interpreting events and messages. While equivocality may not be eliminated, and so managerial choices may still be less than optimal, the lack of optimality is more a function of the inherent equivocality in the situation than it is a function of the flow rate of the incoming data. This is especially true given our third and next reason for not believing information overload to be characteristic of managers' information environments.

Managers are undoubtedly prone to the same information processing biases (Tversky and Kahneman, 1974; Sage, 19xx) that affect other humans. But as Connolly (1980) and Hogarth (1981) note, these are often not as debilitating in environments where time is available to reduce uncertainty and ambiguity through cogitation, experimentation, advice seeking, and other common behaviors. The question is, do decision situations where the density or equivocality of the information environment are high generally require fast action? We think not. Except for crises which by definition are

atypical (and do not necessarily involve information overload), most important decisions in organizations take many months or even years to complete (Witte, 1972; Hah and Lindquist, 1975; Mintzberg, Raisinghani and Theoret, 1976)--thus the rate at which uncertainty and equivocality must be reduced is not great. Even in decision situations requiring resolution in a matter of days, information overload would seem to us to be less a problem than information insufficiency.

We have argued here that the arrival rate of data is not a serious problem for managers, that managers do not suffer from information overload so much as they suffer from information insufficiency or from work overload more broadly defined. We are not certain of our conclusions, however, and are curious about the nature and antecedents of the possible exceptions. We note that today as in 1980, "almost no research has been conducted on information overload and underload of individuals in organizational settings" (O'Reilly, 1980: 685).

5.0 Summary and Research Needs

This chapter has delineated the state of knowledge about information environments. The fact that other authors would have addressed subtopics different from the ones we addressed is not surprising; such is the nature of reviews. Differences in the foci or boundaries of reviews, however, are especially likely when the primary topic of interest has no widely accepted definition. This fact introduces the need for research into the nature of the information environment construct. The following issues seem worth investigating.

- (1) The construct of information environment as that which is sensed is intermediate between the construct of the actual physical environment and

the perceived environment. In the context of organizational communications, is the construct necessary? Under which conditions might we be able to ignore it and when can we not safely ignore it?

(2) In this chapter we have suggested density and interpretability as useful properties to assign to the information environment construct, recognizing that interpretability is also dependent upon properties of the person whose information environment we are considering. What are useful properties of the construct?

(3) The chapter was structured using a hierarchical typology of information environments, dealing with the organization's external and internal information environments and the organizational members' personal information environments. This structure seemed useful, but what typological structure would be more generally useful? Even in the chapter, this structure was not totally satisfactory, as we will point out when we examine research needs within the three hierarchical categories.

Let us turn to the research needs concerning the external information environment. It seems that the role of organizational communications as a process through which the external information environment is created could be sharpened if the several relevant literature were looked at simultaneously and an integrative theoretical model developed. As examples, the literatures on technology transfer across organizations, an industrial intelligence, and on networks of professionals may well have common threads or linkages that could lead to a rich integrative theory concerning the role of communication in creating external information environments. Further, none of these literatures is by itself composed of a large number of empirical studies, so there is room for empirical research as well as a need for conceptual integration.

When discussing the organization's external information environment we noted that the construct of perceived environmental uncertainty could be regarded as either an estimate of some objective property of the environment or as a personal affective response to the environment. We believe this distinction deserves further exploration. It may be, for example, that if the empirical literature on PEU were segmented according to which of the two subconstructs was used, the literature would be less ambiguous and we would learn more than we have. This would be especially true if meta-analysis could be used to aggregate the results of the studies within the two literature segments separately.

We introduced two topics, (1) perceived environmental uncertainty and (2) communication as a process by which external information environments are created, in the context of external information environments. Clearly they could have been introduced in the context of personal information environments (especially of top-level managers) as well. This highlights an imperfection in the hierarchical typology of information environments used here.

Turning to the internal information environment, we see two principal research needs. One concerns the routing of work-related messages. How can individuals, especially boundary spanners, be helped to make wise decisions about to whom to communicate specific items of information? We noted earlier a number of situational variables that do and probably should impact routing decisions, but whether these variables will have an appropriate effect depends on whether the potential sender "knows the situation", knows for example the information needs of potential receivers. Very little research has been directed at how potential communicators can be helped to

make wise decisions about the routing, packaging, and timing of specific messages.

The second research need associated with internal information environments is broad and not easily defined. The literature relating to the logistics perspective is fairly mature and informative concerning how information is acquired and distributed, but we know little about the processes through which it is interpreted. We need to learn more about how interpretation takes place in organizational contexts, and how it might be aided. These are important and large voids in our knowledge of a key role of communication in organizations.

Moving on to the context of personal information environments, we note again the paucity of field research concerning information search and overload as consequences and also as determinants of personal information environments. This seems to be a serious problem, as the larger context within which an information-related issue exists is undoubtedly a determinant of both search and overload and cannot be satisfactorily simulated in the laboratory.

Another matter that deserves attention from organization communication researchers is the relationship between the newer electronic media information interpretation. Do attributes of the media, such as its unidimensionality and even its speed (relative to the movement of written messages), affect the quality of information interpretation either by reducing the opportunity or propensity for cogitation or by increasing the opportunity or propensity for information sharing? Research addressing this question fits nicely within the set of major issues examined in this chapter; the electronic media are a clearly identifiable means of communicating in organizations, their unique properties have a relatively

uninvestigated impact on the nature of the information environment of the message receivers, and they seem to pose special problems and opportunities with regard to information interpretation as this is affected by the sharing of information content.

Footnotes

1. In this chapter we use the term information in its everyday, layperson sense to refer to symbols and other stimuli that affect our awareness of our environments, as contrasted with its technical definition as a measure of uncertainty (see Shannon and Weaver, 1949). Thus one's information environment consists of that which is sensed, a partial representation of one's actual environment and the basis from which one creates a perceived environment.

2. For purposes of edification, we have made a sharp distinction between the two dominant perspectives on organizational environments, the resource-dependency perspective and the information perspective. While much of the literature on external organizational environments falls clearly into one or the other of these perspectives, not all of it does. Of particular interest is the literature concerned with how organizations use communications to affect their environments, and thus attain a favorable resource dependence relationship. Examples are Miles's study of the tobacco industry's response to the findings of the Surgeon General and the consequent federal regulation (Miles, 1982) and Walker and Van de Ven's study of interorganizational coordination among child care and health organizations faced with changes in resource availability (Van de Ven and Walker, 1984).

3. When the probabilities of the possible states are near zero or one, uncertainty is less than when the probabilities are more uniformly distributed across the states. The states are those described as possible

by the observer and the probabilities are, of course, subjective estimates reflecting the observer's degree of belief that the respective environmental states will occur.

4. This section draws heavily on Huber (1982).

5. Linda Trevino provided substantial assistance with the development of this section.

6. Research will help determine the relative effectiveness of picture phones and video/teleconferencing as electronic media for conveying the meaning of verbal messages as well as their content, i.e., as media for enhancing information interpretation.

7. In her recent summary of some of the work on managerial attention and time allocation, Sproull noted that "the difficulty with such general labels (such as function labels or role labels) is that most managerial activity can be labeled by more than one purpose category; hence, assigning single labels is misleading (Sproull, 1984: 12).

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HOW ORGANIZATIONS LEARN:
A COMMUNICATION FRAMEWORK*

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Abstract

What is known about organizational learning is principally found in two perspectives, the systems structural perspective and the interpretive perspective. The literatures associated with the perspectives are described. The perspectives themselves are first contrasted and then, using a communications framework, are shown to be closely linked. The communications framework involves and elaborates the constructs of information equivocality, information load, and media richness.

HOW ORGANIZATIONS LEARN:
A COMMUNICATION FRAMEWORK

1. Introduction

Next month, after 153 years of production, the last fire truck will roll off the quarter-mile-long assembly line at American LaFrance in Elmira, N.Y. American LaFrance once ruled its marketplace as well as any American company ever dominated a business. But the parking lot is mostly empty now, and it's hard to find a person in Elmira who clearly understands why the company is closing up shop. Executives directly in charge at LaFrance offer no explanation. Figgie International, the conglomerate that has owned it since 1966, cites LaFrance's dated truck designs, high overhead and a string of losses, culminating last year with a pretax loss of \$7.6 million on flagging sales of \$21.5 million (Merwan, 1985).

Why does a company like American LaFrance fail? How, in just a few years, could a preeminent franchise built on eight generations of craftsmen come to fall woefully behind the competition?

The answer is "Emergency One," only eleven years old, an upstart manufacturer of fire trucks that tried a new idea--make the bodies of fire trucks out of aluminum rather than steel. This revolutionary idea has made Emergency One the market leader because aluminum doesn't corrode and is cheaper in the long run for fire departments with tight budgets.

Emergency One also revolutionized the assembly process for fire trucks. American LaFrance spent a week handdrafting blueprints for each order. Emergency One does the same thing in a few hours with the aid of a computer. American LaFrance took six months to manufacture a basic fire truck; Emergency One takes one and one-half months.

Emergency One has been especially creative in establishing links with customers. It lent new fire trucks to the Boston Fire Department, and sales executives lived at the Boston fire house and went out on sixty fire calls.

The company also flew twenty fire chiefs to Florida to drive trucks home that were purchased by other departments in their locale.

For American LaFrance, tradition was blinding. American LaFrance grew out of touch with customers, with new technology, with industry changes. We hear of other companies that lost touch with the environment, suddenly found themselves in a crisis, and ultimately failed. Braniff Airlines, Penn Square Bank, Air Florida, Columbia Data Products, Osborne Computers and Facit Corporation (Starbuck, 1983) all shared a common fate with American LaFrance. They did not listen. They did not see. They did not react. These organizations failed to acquire accurate information about environmental events, or they did not interpret it correctly. They did not learn.

If organizational scientists could create and validate operational theories of how organizations learn, and if they could cause organizations to learn and effectuate these theories, then some of the wasted resources associated with organizational failures such as American LaFrance's might be diminished. An early step in enacting this scenario is to assess where we stand in the development of operational theories of organizational learning. In this chapter we make this assessment and propose a new model of organizational learning. Our goal is to define two perspectives on organizational learning and to contrast and connect them, and thereby to facilitate movement from metaphor making to theory building.

Organization Theory and Organizational Learning

It is rarely made explicit, but organizational learning has been a key assumption in organization theory since the 1950's. A large proportion of the literature on organizations concerns organizational adaptation to the environment. Early and oft-cited pieces are those by Burns and Stalker

(1961), Emery and Trist (1965), Lawrence and Lorsch (1967), Terreberry (1968). More recent are those by Miller and Friesen (1980) and Zammuto and Cameron (1985). Implicit in this idea that individual organizations adapt to their environment, are the ideas that organizations learn what their environment is and which organizational design features work best in their particular environment.

Another large proportion of the literature concerns the nature and extent of congruence among major organizational characteristics such as strategy, structure, and technology. Examples of research from this perspective are Perrow (1967), Miles and Snow (1978), and Hambrick (1982). While arguments and evidence can be marshalled to support the contention that the observed pairings of these characteristics are a consequence of natural selection (Hannen and Freeman, 1977), it is also true that arguments and evidence can be marshalled to support the contention that organizations learn which pairings facilitate goal achievement by copying, by experimentation, or by trial and error (Aldrich, McKelvey, Ulrich, 1984; Dutton and Freedman, 1985). Thus a manufacturer who moves to a "defender" strategy (Miles and Snow, 1978) learns that a formalized structure is congruent with the long-linked technology that makes the strategy viable.(1)

Perspectives on Organizational Learning

In their editorial introduction to the topic of organizational learning, Argyris and Schon noted that "the term, 'organizational learning', has been used in many different ways and figures in many sorts of research enterprises" (Argyris and Schon, 1983, p. 3). Not surprisingly, articles that have reviewed literature on organizational learning have attempted to cope first

with the task of interpreting the concept "organizational learning," and second with integrating the growing literature on the topic.

Shrivastava (1983) addressed these problems by integrating the extant literature on organizational learning into four approaches. These approaches represent distinct views on the complex topic of organizational learning. The four approaches proposed by Shrivastava are:

1. Adaptive learning. Organizations adapt to problems, opportunities, and changes in the environment by adjusting goals, decisions, and behaviors. Learning is incremental through the adjustment of goals, search, and decision making (c.f., Cyert and March, 1963; March and Olsen, 1976; Mintzberg, et al., 1976).
2. Assumption sharing. Organizational theories-in-use result from shared assumptions and values. Learning involves changes in these theories (c.f., Argyris and Schon, 1978; Mitroff and Emshoff, 1979; and Weick, 1979).
3. Development of knowledge. Learning is the process of acquiring knowledge of the relationship between organizational actions and environmental outcomes (c.f., Duncan and Weiss, 1978; and Dutton and Duncan, 1981).
4. Institutionalized experience. Learning curve effect through size and bureaucratic procedures. Learning is an accumulation of efficiencies through experience and tradition (c.f., Boston Consulting Group, 1968; Yelle, 1979).

Another recent approach examined the definition of learning. Fiol and Lyles (1985) argued that the literature on organizational learning dealt with

either cognitive changes or behavioral changes by the organization. Cognitive change pertains to new shared understanding and conceptual schemes by organization members. Behavioral development pertains to new responses, action, or structures. Based on these two types of change, Fiol and Lyles proposed a distinction between learning and adaptation. Learning is "the development of insights, knowledge, and associations between past actions, the effectiveness of those actions, and future action" (p. 811). Adaptation is "the ability to make incremental adjustments as a result of environmental changes, goal structure changes, or other changes."

The concept of learning thus is multidimensional and complex. We view the literature on organizational learning as reflecting two basic perspectives, which we will call the systems-structural perspective and the interpretive perspective. The systems-structural perspective on learning is drawn from the systems-structural view of organizations described by Astley and Van de Ven (1983). This is a rather mature organizational perspective at the organizational level of analysis that makes deterministic assumptions about organizational activities. This view in organization theory is also similar to what Burrell and Morgan (1979) referred to as the functional paradigm of organizational analysis. This perspective on organizational analysis can be seen in the rational, logical approaches to organization structures, and would include the institutionalized experience and development of knowledge approaches described by Shrivastava. In section 2, this perspective on organizational learning is described in detail.

The interpretive perspective is the more recent and novel approach to organizational learning. This perspective is closely associated with what Burrell and Morgan (1979) called the interpretive paradigm of organizational analysis.(2) This paradigm in organization theory is concerned with the

deeper processes, conflicts, interpretations, and power relationships that underlie surface structure. The interpretive paradigm relates to the higher level learning described by Fiol and Lyles (1985), and the assumption sharing and adaptive learning perspective described by Shrivastava. In section 3 we will describe the interpretive perspective on organizational learning in detail and suggest steps necessary to move it from its present metaphoric status to an operational tool for organizational scientists.

The idea that survival and other measures of organizational effectiveness tend to be higher for organizations that create an alignment between their characteristics and their environments seems commonsensical. But the pressing question is, "How do organizations learn about their environments?" The systems-structural and interpretive perspectives provide divergent answers to this question.

2. Systems-Structural Perspective of Organizational Learning

Information is acquired by and distributed within organizations for several reasons.(3) It is used as a weapon in intra-organizational debate (Sabatier, 1978). It is a source of power (Spekman, 1979; Shukla, 1982). It serves as a justification for ideologically-based decisions (Sabatier, 1978). It serves as a symbol of adherence to norms (Feldman and March, 1981). It also contributes to organizational learning (Wilensky, 1967; Hedberg, 1982; Nonaka and Johansson, 1985).

Information Acquisition

The systems-structural perspective emphasizes the acquisition and distribution of information as a resource that is necessary for an organization to learn about its external and internal environments. The

literature dealing with information acquisition is separable into that in which the organization or department is the unit of analysis (the "macro" literature) and that in which the individual is the unit of analysis (the "micro" literature). To a great extent, the macro literature on information acquisition is dominated by the writings of researchers interested in environmental scanning for strategic management (c.f., Aguilar, 1967; Hambrick, 1982; Dutton and Freedman, 1985). With hardly any exceptions, this literature is descriptive, largely reporting state-of-the-art case studies or surveys (c.f., Pyke, 1970; Fahey, King, and Narayanan, 1981; Jemison, 1984). The learning implied is often of a low order--a readily interpretable fact is observed, such as the market availability of a Nobel prizewinner or a new computer disk drive, and communicated to those organization departments best positioned to use this information.

The micro literature focuses on boundary spanning personnel as sensors of the organization's environment. Research on how boundary spanners learn about the environment and how they help centrally located units to learn is almost entirely limited to two streams of research. One of these, the literature on gatekeepers in the research and development industry (Pelz and Andrews, 1966; Allen, 1970) is relatively mature; there are empirical studies that build upon earlier conceptualizations and empirical studies (Tushman, 1977; Gerstenfeld and Berger, 1980). A modest theory linking gatekeeper characteristics and behavior to organizational performance has evolved (Tushman, 1979; Tushman and Katz, 1980; Tushman and Scanlan, 1981). A second and slowly developing stream of research deals with the environmental monitoring behavior of upper-level managers. It is less mature, consisting largely of field studies of managerial activities (Keegan, 1974; Mintzberg, 1975; Kurke and Aldrich, 1983; Allinger, 1984). Somewhat related to these two streams of research are the

empirical studies that examine the idea that organizational members, including boundary spanners, tend to search for information from readily accessible sources (O'Reilly, 1982). Theory-testing studies of boundary spanners as sensors of the environment are still rare (but see Leifer and Huber, 1977, and Schwab, Ungson, and Brown, 1985).

Information acquisition occurs in two forms, monitoring and probing. Organizations monitor their external and internal environments in order to identify problems and opportunities. Monitoring or scanning is often passive and routinized, as when sales people are required to report competitors' sales or car dealerships are required to report observed manufacturing defects. Probing occurs when organizational members or departments actively initiate focused inquiries into the environment when more information is desired. These deeper examinations of environments are responses to concerns about actual or suspected problems or opportunities. Some of the search for information observed in organizations is undertaken by individuals seeking to develop or maintain a better understanding of their environments. Example probing behaviors include surveys of customers, phone calls to key contacts, and attending conventions or industry trade shows.

While the information thus obtained may result in the eventual fulfillment of organizational goals, it is obtained for the collector himself, or herself, rather than for the direct use of other units. For example, many officials regularly scan certain data sources (such as The Wall Street Journal or Aviation Week) without any prior idea of exactly what type of information they are seeking or will find. They do this not because they are dissatisfied, but because past experience teaches them that new developments are constantly occurring that might affect their present level of satisfaction (Downs, 1966, p. 169).

Information Distribution

Organizations purposefully disseminate information to carry out the

functions of decision making and control or, in other words, to learn what to do and what needs to be done differently. In many cases, this effort requires the processing of a large number of information-conveying messages. On the other hand, because a large number of messages may cause an overload on the cognitive or logistical capabilities of the individuals and work groups involved, organizations are forced to seek efficiencies in their internal communication systems.

Two processes that organizations and their members use to increase the efficiency of their communication systems are message routing and message summarizing. Both are carried out both formally and informally. Message routing causes any particular communication or message to be distributed to relatively few organizational units. This selective distribution reduces the information processing load of the departments charged with summarizing or transmitting the message and of the many potential receiving departments having little or no use for the information. Message summarizing plays a similar role. It has as its purpose reducing the size of the message, while at the same time, faithfully reproducing its meaning. For example, large sets of numbers are replaced by their "averages" or by "exceptions," and multi-page reports are replaced by appropriately derived recommendations or conclusions. Summarization can greatly reduce the cognitive or logistical load on the departments having to process the message.

Messages vary considerably in relevance, length, accuracy, timeliness, and other attributes. As a consequence of this fact and the need to control their work load, the organizational units responsible for routing and summarizing exercise some discretion in the way they handle messages. This discretion allows two other information-processing phenomena to occur in

parallel with summarizing and routing. These are message delay and message modification.

There is no value judgment or negativism implied in the use of the phrase message delay. Since the priority assignment given a message is a principal determinant of the time it will be delayed, and since making such assignments is a delegated and discretionary act, it is often difficult to make objective judgments about the excessiveness of individual delays. Message modification refers to the distortion of message meaning. Its source may be either the cognitive limitations or the motivations of either the sender or receiver. Modifications may be conscious or unconscious, well-intended or malicious. They range from the well-intended correction of minor errors to the extreme modification of substituting one message for another.

For the most part, the empirical literature on these four processes has used individuals as the unit of analysis. (See, for example, the reviews by Porter and Roberts, 1976, and Huber, 1982.) The more macro literature dealing with the distribution of information has focused on the process of coordination or "integration" (c.f., Lawrence and Lorsch, 1967, 1969). An important component of this literature has a prescriptive orientation. Thus Simon (1973) argues that organizations should be designed such that their units require minimal information exchange with other units, and Galbraith sets forth numerous organization design guidelines for coordination and integration (Galbraith, 1977). To summarize, the systems-structural perspective of organizational learning focuses on reducing ignorance by providing data. Information is treated as if it is a tangible good that is transported in containers called messages. Data are acquired by boundary units or personnel who use the data and/or distribute it to appropriate departments. The focal use of information, as reflected in the paradigm, is

as input to decision-making or controller-coordinator units. It is implicitly assumed that these units know how to use the information, that they merely need to obtain "the facts" in order to take action.

3. Interpretive Perspective of Organizational Learning

The interpretive approach focuses on the underlying purpose and meaning of messages. From the interpretive perspective, data mean nothing until they are used by organization participants. Information can be defined as data that have utility, reduce uncertainty, or changes one's understanding about the external world (Daft and Macintosh, 1981). Research using the interpretive perspective is concerned with symbols and their meanings, and how individuals create and interpret those symbols (Putnam, 1983; Ritzer, 1975). Specific issues of concern in this perspective are the cognitive interpretation of messages, the means through which shared interpretations are reached, and the media through which messages are transmitted.

The concept of the information equivocality is central to the interpretive perspective. When managers observe an external event, the information cue may be ambiguous and have several interpretations. Managers are unclear about what the event means or how to translate it into organizational action. New data may be confusing, and may even increase uncertainty. Weick proposed that organizations must be designed to reduce equivocality from the environment (Weick, 1979). Organizing requires the development of a common grammar for resolving ambiguity. When managers are confronted with an equivocal issue, they discuss the issue among themselves and gradually arrive at a common interpretation and frame of reference. Managers talk things over and enact a solution. Ambiguity precipitates discussion and the exchange of views rather than the collection of additional

data. Managers define or create an answer based on their definition of the event.

The notion of equivocality is intriguing because it contrasts with the concern for data and messages in the systems-structural perspective. The interpretive perspective argues that organizations do more than process large amounts of data. Environments can be confusing, impenetrable, and changing. Managers interpret an ill-defined environment and define a course of action for participants. This approach avoids the assumption that data are concrete and fully interpretable. Managers organize cues and messages into meaningful patterns by imposing interpretations (Weick, 1979; Smircich, 1983). Moreover, emphasis is on shared meaning. The problem for administrators is interpreting and knowing the world rather than controlling the organization. For an organization to learn, equivocality must be reduced to an acceptable level. Indeed, the essence of organizational learning is the reduction of equivocality, not data gathering. The interpretive perspective deemphasizes the rational aspects of communication attributed to the systems-structural view. With respect to the larger organization in which learning occurs, phenomena such as coalitions, power, and conflict influence learning from the interpretive perspective more than do the traditional organization concepts of technology, environment, and size (Zey-Ferrell, 1981).

4. Summary of Two Views

Key assumptions of the systems-structural and interpretives of organizational learning are summarized in Exhibit 1. Fully understanding organizational learning requires viewing the organization as a structure both for acquiring and distributing data and for interpreting and sharing meaning. The systems-structural perspective assumes a system for handling messages,

while the interpretive perspective assumes a system for giving meaning to data. Learning from the systems-structural view is a consequence of the number, direction, and physical characteristics of messages. The external environment is objective, and can be understood through data acquisition. In the interpretive perspective, learning occurs through information content and the sense making behavior of participants. Interactions among human beings are more important than frequent messages. The environment is equivocal and is interpreted through the enactment and shared definition of the membership. Organizations learn through joint discussion and interpretation of events, and through gradual changes in the assumptions, symbols, and values of participants. Moreover, in the systems-structural view, new cognitive understanding typically precedes information acquisition, so that acquired data lead to action. In the interpretive view, trials and errors, or actions and outcomes, are important means of learning. Thus, new organizational actions often precede understanding. Managers learn by doing.

Exhibit 1 about here

Both views of learning are important. Both perspectives in Exhibit 1 are legitimate ways to study and understand organizational learning. Indeed, either view may be accurate depending on the contingencies facing an organization. These views represent two information paths that organizations must travel if they are to learn. The systems-structural perspective focuses on information acquisition and distribution. The interpretive perspective focuses on information interpretation and sharing. The point we make in this paper is that organizations undertake both types of activity. The approaches are not mutually exclusive. Organizations have an objective structural

framework through which tangible data and messages are transmitted and stored. They also have human participants who engage in day-to-day interpretive processes that make sense of events and reduce equivocality. In the next section we begin to integrate these two perspectives and show how organizational learning includes both the handling of data and the reduction of equivocality.

5. Information Load and Learning

In order to learn, organizations must solve two problems. One problem deals with the need to acquire and distribute information about their external and internal environments (Huber and Daft, 1986). Fulfilling this need, and determining whether the amount of information is sufficient, excessive, or optimal, is a logistics problem and is reflected in the systems-structural perspective. The second problem concerns the need to reduce equivocality, to develop a shared interpretation of messages that have been received through the logistical system. The interpretation and sharing processes reflect the interpretive perspective. Solving the logistics and equivocality problems results in organizational learning. But solving the logistics and equivocality reduction problems creates an information load on the organization.

Information load is defined as the volume of information inputs required for an organization to perform its tasks (Farace, Monge, and Russell, 1977). Information load is reflected in the amount of organizational resources allocated to information processing. An organization experiencing an uncertain, complex and variable environment will allocate many resources to scan and interpret the environment. An organization experiencing a high

Events are poorly understood, and there are a large number of events to be dealt with and interpreted. Special surveys and probes into the environment may be combined with extensive discussion and judgment to reach decisions. Organizations in this situation are characterized by rapidly changing environments, as would occur in an emerging industry, or during rapid technological development. The amount of organizational learning in Cell 2 would be very high.

Cell 3 reflects a low information load because both information amount and equivocality are low. The need for organizational learning is minimal, and organizational responses are normally from memory, as stored in precedents, scripts, and procedures. Organizations in Cell 3 would be perceived as traditional bureaucracies where the goal of learning is to attain efficiencies through experience and the repeated performance of a stable task. Learning is low.

Cell 4 is defined as moderate-high information load because the volume of data processed about the environment is large. This situation is typified by a large knowledge base and many external events. The organization needs to adopt mechanisms to process and integrate a large volume of data. This could include the adoption of new specialists, positions, and departments or the use of new communication technologies to help in monitoring many environmental sectors simultaneously. Learning in Cell 4 is typified by planning, data collection, and data transmission. Organizational learning is moderate to high.

6. Information Media and Organization Learning Capacity

How can organizations process information sufficient to meet the moderate to high loads required of many environments? How can managers receive

information displays, be involved in trial and error, and in other ways interpret the environment? The answer is capacity, capacity to increase the volume of data processed by the organization, and capacity to reduce equivocality. One approach to increase capacity for data volume is to add resources to information processing activities. Additional people could be hired or departments created, communications could be routed or summarized in new ways, or new technologies could be adopted to increase information flow.

A more difficult problem is how to increase the capacity to reduce equivocality. Here the emphasis is on clarifying and defining reality, on managers reaching a consensus about the environment and organizational actions. Increasing the logistical capacity to process data will not necessarily increase the organization's ability to understand an equivocal environment. If an organization is designed to learn, an important aspect is the implementation of appropriate communication channels and connections, through which data and messages are processed. Channels influence the organization's ability to transmit data as well as participants' ability to interpret messages. We propose that the concept of media richness, which is related to the channel or medium used for conveying information, influences capacity for organizational learning. Media have the ability to increase data processing or help managers interpret ambiguous events depending on the information load and learning requirements.

Media Richness

Organizations process information through many channels, and recent research indicates that these channels are not equal in their capacity for facilitating understanding. The need for organizations to have a high information capacity is reflected in the observation that managers spend a

information load will typically be coping with both the logistics and interpretive problems.

The relationship among the information logistics problem, the equivocality reduction problem, and the concepts of information load and learning are illustrated in Exhibit 2. The equivocality of information, and the extent to which equivocality must be decreased in order for the organization to take action is illustrated on the vertical axis of Exhibit 2. This is the interpretive problem for organizations. The horizontal axis in Exhibit 2 reflects the amount of information that must be acquired and distributed, which is the logistical problem. The diagonal in Exhibit 2 is information load, and as load increases, learning demands on the organization also increase.

Cell 1 represents a situation where the environmental events that influence the organization are equivocal and poorly understood. These events may be infrequent, but when they arise, as in a crisis, managers may not know how to respond. Learning is achieved through equivocality reduction. Managers may talk to enact a common perception, and they rely on intuition and judgment to interpret events. Learning is a process of making sense of the environment, and includes discussion, guesses, hunches, and trial and error. A clear map of the environment is not available. Decision making is incremental as the organization copes with equivocality. The amount of organizational learning in Cell 1 is expected to be moderate.

Exhibit 2 about here

Cell 2 represents an organization experiencing a high information load. The amount of information is high and the level of equivocality is also high.

very large proportion of their time communicating (Mintzberg, 1973). But managers do not use all channels equally. A number of studies have observed that managers prefer face-to-face communications (Mintzberg, 1973; Daft and Lengel, 1986; Rice and Bair, 1984). Managers seem attracted to informal channels such as personal meetings and the telephone, and they tend to ignore formal reports and computer based information (Fischer, 1979; Martin, 1983).

The question is, why do managers prefer face-to-face communication? Does the face-to-face medium offer special advantages for organizational learning? Daft and Lengel (1984, 1986) proposed that media selection is closely linked to the amount of learning in organizations. A medium is how information is carried from sender to receiver, and may include telephone, computer printouts, memos, or face-to-face discussions. Daft and Lengel (1984), based on the work of Bodensteiner (1970), characterized media as high or low in richness based on the capacity to convey information. Recall that information is defined as that which can change a person's understanding or mental representation. Media richness is defined as the medium's capacity to change mental representations within a specific time interval (Lengel, 1983; Daft and Lengel, 1984). A medium is considered rich if it provides big insight to managers in a short time. A rich communication transaction results in a major change in mental representation. Media low in richness tend to require a longer time to convey the same understanding, and tend to convey information that is less insightful or helpful for understanding the environment.

Media typically used in organizations can be organized into a hierarchy, based upon the capacity for conveying meaning among organizational members. Exhibit 3 illustrates a media hierarchy with five levels of richness. The capacity of each medium is based on a blend of four characteristics: (1) the use of feedback so that errors can be corrected; (2) the ability to convey

multiple cues; (3) the tailoring of messages to personal circumstances; and (4) language variety.

Face-to-face is considered the richest medium because it allows immediate feedback so that understanding can be checked and interpretations corrected. This medium also allows the simultaneous communication of multiple cues, including body language, facial expression, and tone of voice, which convey information beyond the spoken message (Meherabian, 1971). Face-to-face communication uses high variety, natural language and messages tailored personally to the receiver (Pondy and Mitroff, 1979; Daft and Wiginton, 1979).

Exhibit 3 about here

The telephone medium is somewhat less rich than face-to-face because visual cues are not available. Feedback is fast, but individuals rely only on language content and audio cues to reach understanding. The telephone medium is personal and utilizes natural language.

Written communications are considered lower in richness than oral communications. Written documents, personally addressed, such as letters and memos, are characterized by slow feedback. Only written data are conveyed, so visual cues are limited to those on paper. Addressed documents can be tailored to the individual recipient.

Formal, unaddressed documents are lowest in richness because they apply to everyone in the same way. Examples are fliers, bulletins, written rules, and MIS reports that are impersonal and are not amenable to feedback, although they do use natural language. Visual cues are limited to those in the standard format.

What does the media richness continuum mean for organizational learning?

The answer is that media vary in their capacity to help organizations reduce equivocality. Managerial work is highly fragmented, and managers work under time pressure (Mintzberg, 1973). Time is a scarce resource, and so is information. Information transactions processed through a rich medium allow rapid feedback so that managers can quickly converge on a common interpretation. Richer media allow multiple cues, including body language and facial expression. When managers experience equivocality, rather than search for an objective answer, they resolve it by enacting or defining a course of action. Equivocality reduction takes place through the exchange of opinions, perceptions, and judgments of relevant managers. Managers may bring different frames of reference to the discussion, so disagreements need to be surfaced and resolved. Rich media enable managers to construct a joint cognitive map, and to resolve equivocality through discussion and rapid feedback that would be impossible if communication channels consisted only of letters, electronic mail, or written or numeric documents.

On the other hand, media of lower richness are preferable when messages are unequivocal. For the logistics problem of acquiring and distributing data, especially when the communications are one way, impersonal, and to the point, written and electronic media are efficient. Rules, regulations, memos, and reports convey objective knowledge about well-defined events. Using rich media to convey routine information would be inefficient and could result in overcomplication and needless ambiguity.

The point for organizational learning is that rich media facilitate interpretive learning. When learning is characterized by the logistical processing of objective data, media of lower richness are appropriate. Organizations can learn by tailoring the medium to the nature of messages to be transmitted. Conversely, the wrong medium for a message can restrict

learning. Written media and standard reports would oversimplify messy problems because these media do not transmit the subtleties associated with unpredictable, personal, subjective aspects of organizations and environments. Conversely, face-to-face discussions would contain surplus and perhaps erroneous meaning for objective, well-understood communications, and would be inefficient.

A number of studies are consistent with the argument that as uncertainty or equivocality increases, rich media are the preferred mode of information processing in organizations. Van de Ven, Delbecq, and Koenig (1976) studied coordination under high task uncertainty, which is a high learning situation. Managers preferred face-to-face modes of coordination. Kreps (1980) reported that discussion and feedback cycles increased among faculty senate members when issues were equivocal, and Holland, Stead, and Leibrock (1976) found that face-to-face channels of communication were preferred to written channels when perceived uncertainty was high. Meissner (1969) and Randolph (1978) found that when communications were objective and certain, sources of information such as objects, signs, and written documents were used in departments, while personal communications were used as tasks increased in uncertainty. Bodensteiner (1970) reported a sharp increase in the frequency of face-to-face and telephone media when organizations experienced stress and uncertainty from the occurrence of unanticipated difficulties and problems.

Additional findings were reported by Weinshall (1979), who found that managers selected face-to-face more frequently for the difficult transactions associated with negotiating and advice giving, while telephone and written channels were selected for routine communications such as giving orders or receiving standard information. Rice and Williams (1984) showed that electronic mail, a medium of low richness, was preferred for exchanges of well

defined information, but was not used for bargaining or resolving conflict. Jones and McLeod (1984) found that managers preferred face-to-face media for communicating about difficult aspects of the managers' job. Finally, Kiesler, Siegel, and McGuire (1984) found that when computers were used to mediate communications between people, the ability to solve complex problems was low compared to face-to-face discussions.

All in all, the evidence supports the idea that media vary in their capacity to convey understanding and reduce uncertainty. The use of media is a key element in the amount and type of learning accomplished by an organization. Rich media facilitate rapid feedback and the use of multiple cues so that ambiguity can be brought into resolution and diverse frames of reference can be integrated. Face-to-face communication is a powerful means of resolving equivocality and changing mental representations, which is one important aspect of organizational learning. On the other hand media of low richness are efficient for processing large amounts of objective data, which is the second important aspect of organizational learning. Organizational choices among media will influence what and how the organization learns.

Consequences of Media Usage

The point made above is that media are related to the capacity of an organization to learn. Now we want to go a step further, and propose that the use of media influence the information displays made available to organization participants, and in turn influence decisions based on that information. If we think of managers and other employees as mini nerve centers of organizational learning, what view of the environment is provided to them through media, and what type of decisions will be made? Organizations can consciously emphasize media, and in so doing change the organization's

information base, decisions, and learning. Exhibit 4 summarizes our proposed relationships between media and the way in which individuals perceive and act on organizational information from those media.

Information displays. The upper part of Exhibit 4 proposes how media may influence perceptions of organizational events (Argyris, 1979). By encouraging or limiting cues, a medium filters information and thereby provides a world view different from other media. For example, the use of a medium such as face-to-face discussion is expected to induce individuals to perceive the phenomena as close to them, to think concretely and intuitively, and to be aware of specific events and conditions within the organization and the environment. Rich media are personal, convey emotional cues, and enhance social presence. Rich media also induce individuals to see the equivocal, ill-defined aspects of events, to develop personal networks, and to take personal responsibility for data acquisition and accuracy.

Media of lower richness, by contrast, are expected to induce individuals to perceive events and conditions as distant and remote, and to think abstractly and rationally about those events. When individuals receive numbers and written reports, they are more likely to conceptualize the organization and environment in terms of stable activities, overall trends, and measurable, well-defined characteristics. Individuals relying on written media are more likely to be isolated, to be uninvolved in personal networks, and to accept data as legitimate and authoritative and outside their personal responsibility.

Exhibit 4 about here

Information displays are similar to what Argyris (1979) described as

local versus distant management information systems. Media of low richness tend to carry information about "distant" events, and to describe the organization as a whole. Distant information is universal, objective, and applicable to everyone in the organization. Local information is unique, subjective, and applicable to the circumstances of specific departments and groups.

Decision making. The middle portion of Exhibit 4 describes how information is expected to translate into decision making. Information from media of low richness is expected to induce individuals to think in terms of results and performance, to see major exceptions in performance, to infer causality from data that lack specifics, and to use statistical judgment in making decisions. Media of high richness is expected to influence decisions in terms of the underlying events and processes that cause organizational performance, to detect errors before there are exceptions, to infer causality from a situation's specific circumstances, and to use clinical judgment in making decisions.

We generally expect organizations that rely on media of low richness to use statistical judgment based on calculation and rational procedures. Statistical judgment relies on the frequency and pattern of events. In contrast, clinical judgment relies on close personal knowledge of underlying cause-effect processes and on the way specific events influence one another, which is associated with the use of rich media.

An example of how information influences decisions is Mehl's box in psychology (Wiggins, 1973). The outside of the box contains several lights and buttons, and pushing the buttons will cause the lights to go on in different combinations. Statistical judgment would involve collecting data about which lights come on in correlation with which buttons are pressed. By

using frequency counts and statistical logic the odds of any light coming on can be estimated. However, a skilled mechanic who has experience repairing similar boxes would not need to make statistical judgments. He would adopt a clinical approach based upon information about internal mechanisms. He would look inside the box to construct a theory about the internal arrangement of gears, wires, and electricity to understand which light will come on when each button is pressed. Similarly, a clinical psychologist dismantles mental processes to understand individual behavior, while a research psychologist may rely on correlations between questionnaire responses and behavior. The objective data acquired through formal, written media is expected to lead to different decision processes than will subjective cues acquired through rich, personal sources.

Culture and values. The final aspect of media selection proposed in Exhibit 4 pertains to media impact on internal culture and human values. Media can be warm versus cool with respect to the ability to convey emotions. Written media and its substitutes are considered "cool" because they are impersonal, and communicate facts and figures. Formal reports and official memos are rational and business like. These media are preferable when the organization seeks values of logic and efficiency (Rice, 1984). The criterion of rationality dominates organizational culture when media of low richness are emphasized.

Face-to-face media, the telephone, and substitutes such as picture phones and teleconferencing, are "warm" media. These media are able to deal with human relations, personal opinions and emotions. Senders and receivers have a social presence (Rice, 1984). Group norms, trust, and affection can be communicated through rich media. Personal differences and emotional conflicts can be surfaced and resolved. Personal influence and persuasion can be used.

Warm media enable individuals to negotiate and resolve issues of power, status, and conflict, while cool media emphasize impersonal facts and stable events. Thus we propose that the frequent use of a medium can influence whether the organization's culture is perceived as warm, caring, and emphasizing personal values, or whether the cultural values are cool, calculative, and performance oriented.

7. Designing Systems for Organizational Learning

Now we want to bring together several ideas presented in this chapter to propose specific design characteristics that enable organizations to learn. In order to learn, organizations have to solve both the logistics and interpretive problems. They must both process data and be able to interpret equivocal cues. Organizations thus need to design two systems--a logistical system to handle the processing of data, and an interpretive system to enable the appropriate perception and understanding of data. Organizations can be designed with characteristics to increase the capacity of either system.

Designing the Logistical System

How do organizations acquire and handle a large volume of data when needed for learning? Examination of the literature suggests three methods, which we call organization structure, communication strategy, and technology.

Organization structure. Perhaps the single most important way to increase the volume of information is to add organizational positions or departments designed to process data and messages (Huber, 1984a). As Lawrence and Dyer (1983) noted in their study of environmental complexity, the addition of boundary roles and departments were needed to monitor and interpret

environmental complexity. Boundary spanning individuals and departments act as sensory units to monitor relevant environmental sectors and events.

Structural changes can also be used to process data among departments within organizations. Many organizations have created specialized departments, called information centers or support centers, to help managers identify and obtain needed information (Zmud, 1984). This structural change increases the division of labor and enables personnel to specialize in acquiring and disseminating information vital to organizational learning. New departments can both span the boundary to the external environment and facilitate internal communication and coordination.

Communication strategy. Communication strategy is the organization's approach for acquiring and handling data. There are several parts to an organization's information processing strategy. First, an organization can aggressively search for external information, or it can passively monitor the environment. To the extent that more data are needed, an aggressive posture can be adopted (Aguilar, 1967; Daft and Weick, 1984). Organizations can build special communication links to other organizations, or send agents into the field (Wilensky, 1967). Organizations can formalize and routinize certain types of information, such as periodic surveys of the external environment or periodic internal reports on performance. The organization can explicitly send communication probes into environmental sectors as part of routine communication activities.

A second information strategy is to set priorities to pinpoint critical information that can be summarized or "chunked" into meaningful units (Farace, et al., 1977; Huber, 1982). Chunking information prevents managers from being subjected to an endless stream of facts. The information is broken into meaningful units that apply to specific questions. A third strategy is to

choose whether the organization wants to centralize or decentralize the responsibility for information. Decentralization means that major departments are responsible for their own information acquisition and dissemination, which prevents information overload on the central processing department. Decentralization also makes departments responsible for selecting data relevant to their needs.

Technology. The technology for processing information has undergone a revolution in recent years. The new computing and communication technologies have been called the "new media" (Rice, 1983). Such electrically-based communication technologies provide an enormous opportunity to enhance the volume of data that can be processed through organizational channels (Huber, 1984a). The new media include teleconferencing, electronic mail, voice mail, picture phones, and other forms of organizational wiring. They provide for both storage and transmission of huge volumes of data that would otherwise be stored or transmitted through the written word. Some of the new media, such as teleconferencing and picture phones, are designed to supplement face-to-face communication. The new technology is important because it provides multiple and permanent high speed channels for connecting the organization to the environment and for connecting departments together. New media can instantly direct and route messages around the world. The computer can provide a direct link to customers and suppliers, as in the case of American Hospital Supply, Westinghouse and Xerox (Porter and Millar, 1985). Electronic media also provide superb internal coordination, such as when franchises, branches, or overseas offices are hooked directly to the central office for daily exchanges of operating data. Finally, electronic media facilitate the use of more efficient organizational structures (Huber and McDaniel, 1986).

Designing the Interpretive System

Equivocality reduction demands a different approach from that outlined above because new data often do not resolve ambiguous issues. Equivocality reduction typically requires media high in richness, which involve personal communication. Designing the interpretive system is based on organization structure, communication strategy, and technology, but specific elements are quite different from the design of the logistical system.

Organization structure. The structure to facilitate equivocality reduction should place organizational members in direct contact with relevant external sectors to obtain rich information. This would mean structural disaggregation that locates people close to customers, close to suppliers, or close to other elements in the field. People can be assigned to the field for personal observation and reporting back to the organization (Wilensky, 1967). Moreover, disaggregation encourages opportunistic contacts and nonroutine information. Managers are encouraged to be in personal touch with environmental sectors they believe important, and to use trial and error to obtain feedback from the environment.

With respect to internal information processing, equivocality reduction makes extensive use of group meetings and organizational integrators. Group meetings may be in the form of task forces, project teams, or committees (Galbraith, 1973; Lawrence and Lorsch, 1967). These structural mechanisms enable participants to exchange opinions, perceptions, and judgments. Managers are able to establish a common frame of reference and to enact meaning about environmental events (Daft and Lengel, 1986). Integrators play a similar role by personally carrying information back and forth between relevant departments. Integrators act as liaison personnel who coordinate

{ across departments through face-to-face and telephone discussions to overcome disagreement and thereby reduce equivocality.

Communication strategy. To interpret equivocal events and cues, communication strategies should encourage face-to-face contacts and nonroutine information. Personal communications enable individuals to receive information displays that are close to the phenomenon of interest, and to interpret the ambiguous and ill-defined nature of events. Discussions among managers can then be used to reduce equivocality. Group meetings enable managers to enact a shared definition of events. The organization's strategy can encourage members in contact with the environment to bring interpretations and opinions back into the organization for discussion.

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(Another strategy is to encourage few rules for processing data but encouraging rapid cycles among managers. Assembly rules are procedures or guides that organizations use to process data into a collective interpretation (Weick, 1979). When data are clear, rules can be used to handle the processing of routine information to a joint interpretation. Fewer rules should be used for ambiguous information because there is uncertainty as to what the information means, and managers may have to seek out and discuss information in nonroutine ways. Although rules are fewer for equivocal issues, the number of information cycles and exchanges among managers will be greater. Managers should be encouraged to meet face-to-face on a frequent basis so the data can be cycled among members before an interpretation is reached and action taken.

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(Technology. Even though they are not as rich a communication media as are face-to-face discussions, electronically-based communication technologies can be adopted to reduce equivocality to the extent that they possess qualities of richness. Picture phones and teleconferencing enable managers to

see one another, to use multiple cues, and to receive rapid feedback. While these new media do not have the social presence of face-to-face communications (Rice, 1984) and do not as effectively convey subtle emotional, social and power relationships, they do convey richer information than written messages. In addition, some technological devices, such as electronic mail, are richer than written communications because they facilitate frequent messages and encourage rapid information cycles among managers. Finally, Group Decision Support Systems enhance the exchange of information in face-to-face meetings and thereby facilitate the discussions that lead to the development of shared understanding (Kull, 1982; Huber, 1984b). The new media are valuable for equivocality reduction to the extent that they increase feedback and encourage a jointly constructed interpretation among individuals.

8. Toward a Model of Organizational Learning Modes

Now we bring together several ideas to answer the question raised earlier in this chapter, "How do organizations learn?" So far we have (1) defined and compared the systems-structural versus interpretive perspectives on organizational communication; (2) explained how these perspectives define the logistics and interpretive problems for organizations; (3) proposed that learning is a function of the information load facing an organization; (4) introduced the notion that media have different capacities for conveying messages and reducing equivocality; (5) proposed that media can influence information displays, decision making, and values within organizations; and (6) proposed specific design characteristics to resolve the logistics and interpretive problems within organizations.

Given the importance of both the logistics and interpretive systems, we hypothesize that organizations may use one of four learning modes illustrated

in Exhibit 5. These modes represent a gestalt of organization characteristics that define a style or approach to learning based on information load. The gestalt represents congruence among structure, technology, load, media, information displays, and communication structure. The four learning modes include traditional bureaucracy, extended bureaucracy, self-designing organization, and experimenting organization. Each of these modes represents a style of learning appropriate to the logistic and interpretive requirements from the environment.

Exhibit 5 about here

Traditional bureaucracy. The traditional bureaucracy is the appropriate learning mode when both equivocality and logistics requirements are low. New or ambiguous problems do not arise with sufficient frequency to require frequent face-to-face discussions or new data about the environment. The organizational assumption is that learning is based on institutionalized experience. The organization expects to continue the same behavior that worked in the past, only more efficiently. Data relevant to efficient behavior are stored in the bureaucratic records, rules, and in the organization's past experience.

The information load required for the traditional bureaucracy to perform adequately is low compared to organizations in other environments. The information media are both low technology and low touch. "Low technology" means that written media can handle the necessary volume of data. "Low touch" means that face-to-face and personal communications are not needed to reduce equivocality. The information displays made available to administrators within the bureaucracy are characterized as impersonal, remote, objective, and

promote the use of statistical judgment and rational procedures. The communication strategy and structure require relatively few departments with environmental scanning responsibilities, centralized record keeping, few committees and other coordination devices. The organization would have little use for the new computing and communication technology.

Extended bureaucracy. The extended bureaucracy also exists in an environment characterized by a low need for equivocality reduction, but the logistics problem of processing data and messages is much greater than for the traditional bureaucracy. The external environment may be very complex, and hence the bureaucracy must extend itself into the environment to acquire necessary data. The basic learning assumption is that the systems-structural approach is an appropriate mode for learning. The premise for learning from an administrative perspective is the development of an internal knowledge base (Shrivastava, 1983). The organization is expected to acquire data that answers relevant questions, and to plan future actions. The criteria for learning are action-outcome relationships (Duncan and Weiss, 1979).

The information load confronting the extended bureaucracy is medium-high. Appropriate information media are high technology but low touch. New communication technology can help process volumes of data, but managers do not need personal discussions because reduced equivocality is low. The dominant information issue is to acquire large amounts of data about a complex but definable environment. Electronic technology combined with surveys and other systematic data collection are appropriate for an extended bureaucracy. Technology is also used to bring the data into useful summaries for management. The information displays to managers about the organization and its environment will tend to be impersonal, report overall trends, be results oriented, and induce statistical judgment and rational procedures. The

organization's structure would have many boundary spanning individuals and departments, and perhaps special departments designed to obtain useful data.

Self-designing organizations. The self-designing organization is considered opposite the extended bureaucracy. The self-designing organization has to cope with perpetual equivocality, and there is little hard data. This organization exists in an ambiguous and shifting environment, so interpretive systems are more relevant than logistical systems. Facts and figures that describe the environment are not available. The basic assumption within the organization reflects the interpretive approach to learning. Management must enact a definition of environmental events, and they engage in trial and error to figure out the environment. In this type of organization, action may precede understanding. Learning will involve frequent changes in basic assumptions about organizational purpose, mission, and products (Argyris and Schon, 1978).

The information load confronting the self-designing organization is low-moderate. A large volume of data is not processed, although participants spend time figuring out data that are available. Media will be low tech and high touch. High technology is of little use because facts and figures communicated through these media have little value. Managers would be in touch with each other on a regular basis. Frequent meetings to figure out a course of action are needed. The information displays made available to managers by rich media are of a personal nature, pertain to underlying cause-effect relationships, and induce clinical judgment and human values in decision making. The communication structure of the organization encourages the development of personal networks, ad hoc meetings, and disaggregation of the organization so that members can be in personal contact with relevant sectors of the environment.

Experimenting organizations. The experimenting organization is in the most demanding learning situation because the interpretive and logistical problems must both be managed. The organization must simultaneously define the environment and gather hard data about the environment. The underlying learning assumptions represent multiple criteria, including both interpretive and systems-structural approaches to learning, both centralized planning and enactment. The learning premise within the organization would be adaptive learning (Cyert and March, 1963; March and Olson, 1976), and incremental, trial and error decision processes (Lindblom, 1979; Mintzberg, et al., 1976). The experimenting mode of learning is appropriate for a large, complex organization undergoing transformation or confronting unexpected environmental changes. Rational processes may be attempted, and if unworkable, the organization would use more personal, enactive learning techniques.

The information load in the experimenting organization is very high because a large volume of data is needed about definable elements of the external environment, and meetings and discussions are required to interpret ambiguous stimuli. Media would be both high technology and high touch. High technology would enable the organization to scan a complex environment and assimilate data about many events. High touch would enable the organization to use personal interpretations and discussions of events. The information displays available to managers include both personal and impersonal views, and describe both overall trends and cause-effect relationships. The media could facilitate either clinical or statistical judgment depending on the data and the events. The communication structure should include many boundary spanning people and departments, an aggressive approach to data acquisition such as surveys, and disaggregation of structure so that members are involved in direct contact with environmental events. The personal networks of

managers and the technology network are both important. The experimenting organization devotes a large amount of time and resources to information processing, and is expected to experiment with matrix structures, computer networking, and other devices for assuring information for external scanning and internal coordination.

9. Conclusions and Research Implications

We began this chapter with the story of American LaFrance, the fire truck manufacturer that once ruled its marketplace and now is going out of business. The reason American LaFrance failed is that a major competitor, Emergency One, manufactures fire trucks from aluminum, uses computer design techniques, and has aggressively marketed its product to fire departments. American LaFrance failed because it was not equipped to learn about and respond to changes in the external environment. American LaFrance is acting like a "traditional bureaucracy," but it should have been designed as an "extended bureaucracy." American LaFrance did not use marketing surveys, or send people into the field to find out what customers wanted, find out about new technologies, or to discover the actions of competitors. American LaFrance acquired no data on aluminum bodies, on computer designs, or on new assembly techniques. American LaFrance was perfectly designed to continue making fire trucks in the same old way, with incremental efficiencies, but had no knowledge base for larger changes. American LaFrance failed because it was not designed to learn, yet it existed in an environment that required learning and adaptation to survive.

Organizational learning has been implicit in the organizational literature for many years. Previous research and theorizing can be categorized into either the systems-structural perspective or the interpretive perspective on learning. These two perspectives are reflected in the need for

both data logistics and interpretation within organizations. We proposed that media could be used to facilitate either type of learning, and recommended specific design characteristics. The four learning modes--traditional bureaucracy, extended bureaucracy, self-designing organizations, and experimenting organizations--reflect an integration of ideas and research findings from the literature. A great deal of additional work in the area of organizational learning is called for, and specific implications for research are as follows.

1. Perhaps the most urgent need for additional research is to develop organization design guidelines for the interpretive perspective. The field of organizational design already knows a great deal about using the systems-structural perspective for the acquisition and distribution of information (Huber, 1984). For example, techniques, strategies, and technologies to increase the flow of information and reduce its cost are already adopted in organizations. A bigger problem is to develop explicit recommendations for designing organizations with effective interpretive systems, soft and ill-defined as they currently are. At this point we can make common sense suggestions, such as provide managers with the opportunity for face-to-face discussion, have a lounge where people can talk informally, perhaps create a softball team with members from several departments, and scold managers for remaining in the office rather than visiting organizations in the environment. Organizations may be able to consciously design the use of task forces, group decision support systems, and perhaps even matrix structures to encourage the interpretation of equivocal events in a way that produces a logical course of action (Huber, 1984b; Daft and Lengel, 1986).

2. Systematic research into the topic of organization learning is not likely to progress far without initial effort to develop measures that

operationalize basic learning concepts. Many aspects of organizational learning are elusive and ill-defined. Concepts often pertain to understanding as it takes place within the minds of managers, which is hard to identify and measure. Initial research could focus on defining and operationalizing relevant dimensions of the environment, logistics system components, interpretive systems components, media, the nature of messages, characteristics of new communication technologies, information load, and when learning occurs. These are difficult concepts, and their measurement is a full menu for organizational researchers.

3. Yet a third area of potential research is the impact of interpretive and logistic systems on the organization. This research would correspond to the ideas in Exhibit 4 about the information displays, decision processes and internal values induced by the organization's communication system. An organization that emphasizes logistic systems such as written and electronic media could be studied to learn whether managers perceive the world differently than managers in organizations that emphasize interpretation through personal discussion. The impact of media on manager perceptions, mental representations, decision making, and individual versus shared perceptions represent a new and intriguing avenue for understanding the impact of information designs for decision making and learning.

4. At a more micro level, research is needed that focuses more precisely upon individual messages, the media through which they are communicated, and the context of the communication. Initial findings suggest that the matching of messages to media and situation constitutes effective information processing (Lengel, 1983). Yet the surface has only been scratched in this research. Even more important is the need to define the multiple dimensions of messages, media, and situations. How do media differ with respect to

feedback, speed, accuracy, social presence, focus, and so on? What characteristics of messages, such as equivocality, length, complexity, reliability, are relevant to organizational learning? How does the communication situation, including the relationship between sender and receiver, differences in frames of reference, and physical distance affect the learning process? The research questions pertaining to possible combinations of messages, media, and situations seem almost limitless.

5. Yet another needed line of research would involve field studies of the learning relationships proposed in this chapter and elsewhere in the literature. This type of research would compare organizations to see whether the clusters of elements proposed in the model of learning modes hang together in the grouping suggested here, or in any other groupings. Other questions include: How do environmental characteristics correlate with perceived learning requirements within organizations? How do environment characteristics correlate with internal systems for logistics and interpretation? Is an organization's ability to learn correlated with performance? This type of research will enhance our understanding of learning at the organizational level of analysis.

The major conclusion from this paper is the need for organizations to be aware of external events, to acquire and distribute messages about these events, and to try to make sense of things when events are equivocal. In order to learn, organizations have to solve both the logistics and interpretive problems. They must both process data and be able to interpret equivocal cues. Organizations thus need to design two systems--a logistical system to handle the processing of data, and an interpretive system to enable the appropriate perception and understanding of data. Organizations may learn spontaneously and intuitively, but we propose that learning systems can be

deliberately designed to enhance learning and adaptation. The model of organizational learning modes calls attention to different ways of learning that managers and researchers may not have thought about before. Each mode has a learning strength, but is suited to a specific situation. If an organization has been designed in one mode, as was the case at American LaFrance, then it may need to assess whether another mode may be better. The value of any comparative model is that it provides alternatives and new perspectives. The ideas proposed in this paper suggest a viewpoint and model--perhaps a starting point--from which to build toward more complete understanding of how organizations learn.

Footnotes

(1) Although the literature focusing on adaptation and the literature focusing on congruence among internal organizational characteristics have different emphases, they are becoming less distinguishable (Van de Ven and Drazin). This is because (1) the "pairings" of the congruence literature are among the design features of the adaptation literature, and (2) the efficacy of a particular pairing for an organization often depends on the organization's environment. Together they constitute the basis for the contingency theory component of organization theory.

(2) Putnam (1983) and Smircich (1983) summarize and contrast the functional and interpretive paradigms of organizational analysis.

(3) Information theorists distinguish between data and information in the following way--data contain information to the extent that they reduce uncertainty. However, data can also increase uncertainty--can alert you to the presence of conditions you felt certain did not exist. This fact, and the fact that most readers do not make a distinction between data and information, causes us to use the terms interchangeably to mean symbols whose content is understood.

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Exhibit 1. Two Perspectives on Organizational Learning.

<u>Systems-Structural Perspective</u>		<u>Interpretive Perspective</u>
1. Organization is a system for transmitting data.	vs.	1. Organization is a system for giving meaning to data.
2. Amount, frequency, direction, physical characteristics of messages.	vs.	2. Purpose, meaning of symbols, sensemaking of participants.
3. The environment is objective and can be learned through data acquisition.	vs.	3. The environment is equivocal and is learned through shared definition and enactment.
4. Organizations learn by acquiring data, rational analysis and new behavior is then directed by top decision makers.	vs.	4. Organizations learn by discussion and shared interpretation of events, changing assumptions, and trial and error.
5. Understanding leads to action.	vs.	5. Action leads to understanding.

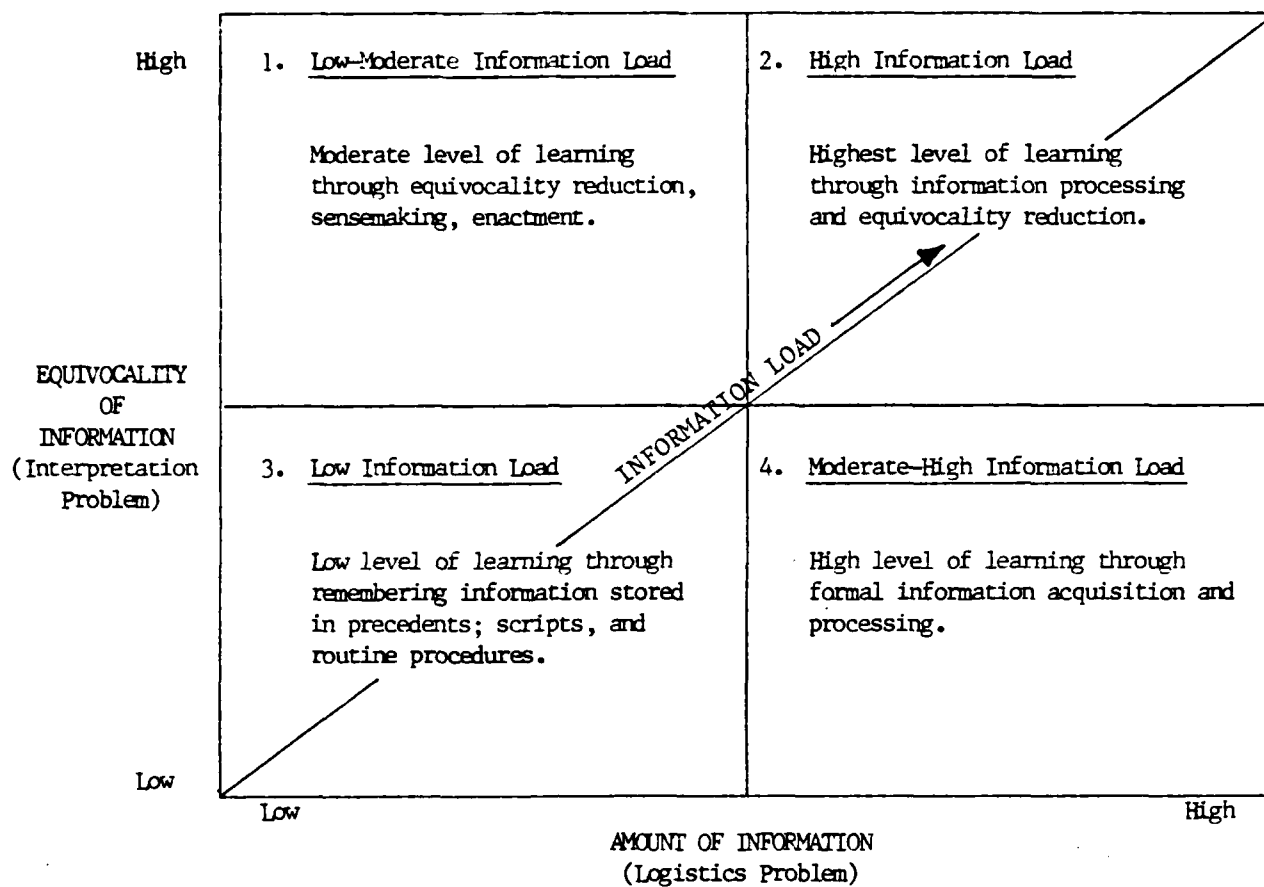


Exhibit 2. Characteristics of Information Load on Organizations.

Medium	Media Characteristics				
	Media Richness Capacity	Feedback	Cues/Channels	Intimacy	Language
Face-to-Face	High	Immediate	Multiple	Personal (visual, audio)	Natural
Telephone		Fast	Audio	Personal	Natural
Written, Addressed (letter, memo)		Slow	Limited Visual	Personal	Natural/Numeric
Written, Unaddressed	Low	Very Slow	Limited Visual	Impersonal	Natural/Numeric

Exhibit 3. Media Capacity and Communication Characteristics.

Source: Adapted from Richard L. Daft and Robert H. Lengel, "Information Richness: A New Approach to Managerial Behavior and Organization Design," in Barry Staw and L. L. Cummings (eds.), Research in Organizational Behavior, Greenwich, CT: JAI Press, 1984, pp. 191-233.

Exhibit 4. Consequences of Communication Media for Information Displays and Organizational Decision Processes.

Media of Low Richness Induce Administrators

Rich Media Induce Administrators

Information Display:

- | | |
|---|--|
| 1. To perceive phenomena as distant and remote. | 1. To perceive phenomena as close and visible. |
| 2. To conceptualize stable events and overall trends. | 2. To conceptualize changing processes and specific conditions. |
| 3. To think abstractly and rationally. | 3. To think concretely and intuitively. |
| 4. To see unequivocal, well-defined aspects of phenomena. | 4. To see equivocal, ill-defined aspects of phenomena. |
| 5. Not to be involved in personal networks. | 5. To develop personal networks. |
| 6. To accept data as legitimate and authoritative. | 6. To take personal responsibility for data accuracy and validity. |

Decision Making:

- | | |
|--|--|
| 1. To think in terms of results and performance. | 1. To think in terms of the events and processes that cause performance. |
| 2. To see errors that are exceptional. | 2. To see errors before they are exceptional. |
| 3. To infer causality from overall trend data that lacks specifics about causal processes. | 3. To infer causality from information about situation specific cause and effects. |
| 4. To use statistical judgment in making decisions. | 4. To use clinical judgment in making decisions. |

Internal Culture:

- | | |
|---|---|
| 1. To convey facts, hard data, measurements, and rational expectations. | 1. To convey feelings, emotions, values, stories and myths. |
| 2. To experience impartiality and removal from the human side of organizational events. | 2. To experience closeness and bonding to people involved in organizational events. |

<p>High</p> <p><u>Self-Designing Organization</u></p> <p>Learning Emphasis: Assumption Sharing. Interpretive approach, exact definitions, trial and error.</p> <p>Information Load: Low-moderate.</p> <p>Media: Low tech, high touch.</p> <p>Displays: Personal, concrete, cause-effect, clinical judgment.</p> <p>Communication Structure: Decentralization, disaggregation, personal networks, group meetings.</p>	<p><u>Experimenting Organization</u></p> <p>Learning Emphasis: Adaptive Learning. Multiple criteria, interpretation and systems-structural, planning and enactment.</p> <p>Information Load: High.</p> <p>Media: High tech, high touch.</p> <p>Displays: Personal and impersonal, concrete and abstract, clinical and statistical judgment.</p> <p>Communication Structure: Personal networks, decentralization, boundary departments, surveys.</p>
<p><u>Traditional Bureaucracy</u></p> <p>Learning Emphasis: Institutionalized Experience. Repeat behaviors more efficiently. Relevant data stored in bureaucratic records and organizational experience.</p> <p>Information Load: Low.</p> <p>Media: Low tech, low touch.</p> <p>Displays: Impersonal, abstract, statistical judgment.</p> <p>Communication Structure: Few boundary departments, centralized, routine data systems.</p> <p>Low</p>	<p><u>Extended Bureaucracy</u></p> <p>Learning Emphasis: Development of Knowledge. Model. Systems-structural approach. Acquire and distribute data.</p> <p>Information Load: Moderate-high.</p> <p>Media: High tech, low touch.</p> <p>Displays: Impersonal, overall trends, results oriented, statistical judgment.</p> <p>Communication Structure: Many boundary departments, surveys, chunk data, satellites.</p> <p>High</p>

EQUIVOCALITY
OF
INFORMATION
(Interpretation)

AMOUNT OF INFORMATION
(Logistics)

THE DECISION MAKING PARADIGM
OF ORGANIZATIONAL DESIGN*†

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THE DECISION MAKING PARADIGM OF ORGANIZATIONAL DESIGN

Abstract

This paper introduces and explicates the decision-making paradigm of organizational design. We argue that the domains of existing design paradigms are declining in scope, and that the nature of current and future organizational environments requires use of a design paradigm that responds to the increasing frequency and criticality of the decision-making process. In particular, we argue that the decision-making paradigm is applicable when the organizational environments are hostile, complex, and turbulent.

The focal concept of the decision-making paradigm is that organizations should be designed primarily to facilitate the making of organizational decisions. The paper sets forth the paradigm's six major concepts and discusses the principal domains of its application. The paper also examines the relationships between the decision-making paradigm and the literatures on (1) organizational decision making, (2) the information processing view of organizations, and (3) the need for compatibility between the organization's design and the design of its technologically supported information systems. The paper concludes by identifying ten organizational design guidelines that follow from the decision-making paradigm.

THE DECISION MAKING PARADIGM OF ORGANIZATIONAL DESIGN

1. Introduction

Overview

In the evolution of many fields of human endeavor, paradigms appear, influence practices in the field, and eventually yield some or all of their influence to other paradigms (Kuhn, 1962).¹ In the past, three paradigms have exerted major influence on the practice of designing organizations. They are the paternalistic/political paradigm, the accountability/authority paradigm, and the workflow paradigm. A fourth paradigm is presented in this paper based on the assumption that decision making has become the central organizational activity. To put this fourth paradigm in context, we will begin by considering the first three.

Perhaps the earliest approach to organizational design involved the tribal leader's allocating tribal resources, including human resources, according to blood ties or political allegiances. This way of thinking about the organizational design task, this organizational design paradigm, is still in use, especially in non-industrialized countries. We will call this perspective the paternalistic/political paradigm. Its focal concept is that when designing an organization it is primarily important to allocate power-enhancing resources, such as authority and subordinates, to people who are likely to be loyal supporters because of kinship or political affiliation. The implied organizational effectiveness criterion associated with this paradigm is maximization of the leader's political power--

effective organizations are those whose leaders have considerable political support. The best-known explication of this paradigm is that by Niccolo Machiavelli (Machiavelli, 1964; Calhoun, 1969).

Another paradigm appeared as populations became more concentrated and collective endeavors more complex. This accountability/authority paradigm manifested itself in the words of Moses when he gave the Israelites the organizational structures to be used in war (Deuteronomy 20.1-20), and became pervasive in early civilizations, notably the Roman Empire. It was central to classical organization and management theory (c.f., Fayol, 1916/49; Fayol, 1944) and to Max Weber's thinking about bureaucracies (Weber, 1947) and it is, of course, widely used in designing modern organizations. Its focal concept is that when designing organizations it is primarily important to specify who is accountable for fulfilling which responsibilities and to allocate, to those accountable, authority sufficient to enable them to carry out these responsibilities. The implied organizational effectiveness criterion is maximization of the probability that those who are assigned responsibilities will fulfill these responsibilities--effective organizations are those whose members fulfill their individual responsibilities.

The industrial revolution contributed to the development and extensive use of a third paradigm, one where organizational structures and processes are designed around the flow of work (Woodward, 1965; Hickson, Pugh, and Pheysey, 1969). Thus we see departments sequenced along assembly lines, we think of purchasing, production, and shipping as departments involved in the transformation and movement of materials, and we occasionally design organizations using socio-technical systems design concepts (Trist, 1981). The workflow paradigm's focal concept is that when designing organizations

it is primarily important to create structures and administrative processes that match the organization's production processes or operations. The implied organizational effectiveness criterion is maximization of either the effectiveness of the production system or the joint effectiveness of the production system and the structural system together--effective organizations are those whose production system is effective.²

In this paper we set forth and formalize a fourth paradigm for designing organizations, and explore the domain of its usefulness. We call it the decision-making paradigm. Its focal concept is that when designing organizations it is primarily important to create structures and processes that facilitate the making of organizational decisions (decisions made within and on behalf of the organizations). The implied organizational effectiveness criterion is maximization of the quality (broadly defined and including timeliness) of organizational decisions--effective organizations are those whose decisions are of high quality. We intend for the paradigm to serve as (1) a framework for organizing thoughts and observations, (2) a basis for developing working hypotheses prior to observation, (3) a communication aid, and (4) a source of organizational design guidelines.

The decision-making paradigm did not evolve from the workflow paradigm, just as the workflow paradigm did not evolve from its predecessors. Rather, each paradigm is a response to a change in the relative importance of various organizational effectiveness criteria. In the next several paragraphs we review some of the changes in organizational environments that have caused the relative importance of effectiveness criteria to change,³ and also examine the current and forthcoming changes in organizational environments that favor development of the decision-making paradigm.

Forces Requiring the Development of the Decision-Making Paradigm

As societies change, so also do the frameworks that guide thinking in various fields of endeavor. For the field of organizational design, three of the paradigms in long use are not as acceptable or useful as they once were, although they still serve well in many situations.

Consider the paternalistic/political paradigm. This approach to designing organizations, while still in use, is out of favor in much of the Western world. Two forces have contributed to its diminished use. One is that the increased efficiency of communication and transportation systems has removed the time and space buffers that insulated many organizations from potential competitors. With increasing competition has come a greater need to rationalize organizational structures and technologies (in the sense that Woodward (1965) uses the word "rationalize,") and to allocate resources to those personnel most qualified to employ these resources on behalf of the organization in its attempts to compete successfully. These personnel are not always the kin or loyal followers who would be the recipients of organizational resources under the paternalistic/political paradigm. In effect, the importance of the "maximize leader power" effectiveness criterion has declined relative to the importance of the "maximize the organization's competitive capability" criterion.

The second force contributing to less frequent use of the paternalistic/political paradigm is Western Society's declining tolerance for favoritism as a practice. Examples include: (1) insistence by unions and civil service organizations that seniority or written tests be major criteria for wage increases, job retentions, and promotions; (2) anti-discrimination legislation that reduces the opportunity for "the establishment" to perpetuate itself by selecting replacement personnel of similar characteristics such as sex, race, and national origin; and (3) a

vociferous press that often publicizes and infers unfairness to acts of favoritism.

The accountability/authority paradigm is also in less frequent use. "Principles" of organizational design derived from classical organization and management theories (c.f., Gulick and Urwick, 1937, and Mooney, 1947), such as those dealing with "unity of command" and "span of control," are used less frequently. One reason for this loss of emphasis is that other sources of power and influence, most notably expertise, have risen in applicability at the expense of position power or authority. In addition, the rising political and technical complexity of many organizational decisions require participative decision making, or at least a diffusion of influence, and consequently of accountability. Decision-making conferences in modern organizations are frequent and important, and are often heavily influenced by staff personnel having no direct authority or direct accountability for the consequences of the decision. In effect, the organizational effectiveness criterion focusing on individuals fulfilling their assigned responsibilities by drawing on their authority, has yielded some of its domain to a criterion focusing on people fulfilling collective responsibilities and drawing on multiple sources of influence, especially expertise, to sway their associates' thinking.

Finally, the workflow paradigm, while still both common and useful, is gradually losing one of its most important areas of application. As manufacturing declines as a proportion of the Western world's economic activity (Toffler, 1980; Naisbitt, 1982), so too does one of the more conspicuous opportunities to apply the workflow paradigm. In addition, in many organizations, marketing, finance, and other functions have gained in importance at the expense of the manufacturing function, and have

consequently exerted greater influence on organizational structures and processes. As the relative criticality of the manufacturing function has declined within many organizations and across the U.S. economy, the relative importance of the "maximize production system efficiency" design criterion has also declined.⁴

In summary, one reason to develop a new paradigm of organizational design is that the applicability of three historically pervasive paradigms has declined. Yet, the concern with effectiveness of organizations and with the design of effective organizations remains (Lewin and Minton, 1986). But why should a new paradigm focus on decision making? One answer to this question follows from ongoing and forthcoming changes in the nature of organizational decision-making processes. "The greater turbulence of the post-industrial environment will demand that organizational decision making be more frequent and faster. The greater complexity of this environment will also cause decision making to be more complex, e.g., to require consideration of more variables and more complex relationships among these variables" (Huber, 1984, p. 933). Thus, because changes in organizational processes generally require changes in structure, it seems reasonable to set forth a design paradigm that focuses on creating structures that facilitate decision making.

A second reason for a new paradigm to focus on decision making follows from the first.

Organizational decision making in the organizations of the post-industrial world shows every sign of becoming a great deal more complex than the decision making of the past. As a consequence of this fact, the decision making process, rather than the processes contributing immediately and directly to the production of the organization's final output, will bulk larger and larger as the central activity in which the organization is engaged. In the post-industrial society, the central problem is not how to organize to produce efficiently (although this will always remain

(an important consideration), but how to organize to make decisions (Simon 1973, pp. 269-270). (*Italics are the authors'.*)

It seems reasonable, therefore, to set forth a design paradigm that facilitates effective accomplishment of the organization's central activity.

It is interesting to note Simon's distinction between production processes and decision processes. Continuing to assume that production processes are the organization's central activity would cause the traditional workflow paradigm to dominate the decision-making paradigm. Instead, it seems that forthcoming conditions call for more extensive use of an organizational effectiveness criterion such as maximization of the quality of organizational decisions.

(The remainder of this paper is organized as follows. In Section 2 we elaborate on the nature of the paradigm by describing its major concepts and the environments where it seems most useful. Section 3 describes some literatures with which the paradigm interfaces, and thus helps to define its conceptual boundaries. In Section 4, we describe a number of organizational design guidelines that follow from use of the decision-making paradigm. Section 5 contains some concluding comments.

2. Elaboration of the Paradigm

(We noted earlier that (1) the focal concept of the decision-making paradigm is that organizations should be designed primarily to facilitate the making of organizational decisions and (2) the implied organizational effectiveness criterion is maximization of the quality (broadly defined, e.g., including timeliness) of organizational decisions. In this section we formally develop the paradigm. As required by Dushkin (1974), we set forth its major assumption and concepts and describe its principal domains of applicability.

The major assumption associated with the decision making paradigm is that decision making is "the central activity in which the organization is engaged" (Simon, 1973, p. 270). The paradigm's major concepts are as follows.

Major Concepts

Organizational design. As a noun this term refers to the structures and processes that organizational members use to achieve desired organizational outcomes. As a verb it means the processes used to choose or create the organization's design. It involves the determination of organizational roles and the relationships among the roles.

Decision making. This term refers to the processes commonly portrayed as occurring early in the "problem solving process" --the sensing, exploration, and definition of problems or opportunities--as well as the generation, evaluation, and selection of solutions.

Central activity. A central activity is one whose successful execution is critical for effective accomplishment of the organization's goals and strategies. For example, a central activity of a consulting company is deciding what to recommend to the client. Central activities need not occur frequently. For example, the central activities of a hospital range from the frequent activity of deciding what actions to take with regard to improving a patient's condition to the infrequent activity of deciding what market niche to fill.

Decision process characteristics. The paradigm calls for organizational designers to establish, or at least selectively nurture, the characteristics of the decision processes that are especially suitable for the particular decision task and setting. For example, characteristics of the decision processes of a consulting company are (1) the actual or

(symbolic use of expertise relevant to the client's problem (Feldman and March, 1981) and (2) the attempt to develop recommendations that will be well-received by the client (Cyert and March, 1963, p. 64).

Primary information sources. Explicit consideration of the information sources appropriate to carrying out the organization's central activity is a major concept of the decision-making paradigm because the information channels that connect decision units to these sources are a key component of any organizational design that results from use of the paradigm.

(Primary structural form. The organization's primary structural form (and decision process characteristics) must facilitate carrying out the central activity, i.e., making decisions. In the case of a consulting company, the paradigm would call for the client's case to be considered as a project, a decision-making project, for which a structural form must be established. Consequently we would expect to see both a project management structure (Duncan, 1979) and a more permanent structure containing units specialized by expertise from which the project team members would be drawn.

In what circumstances are these concepts most applicable? This question leads to the issue of domains.

Domains of Primary Application

(In his well-known analysis of the Cuban missile crisis, Graham Allison identified and employed three models for interpreting organizational decisions (Allison, 1969). Perhaps the most significant contribution of Allison's work was his recognition and articulation of the fact that almost any decision made within and on behalf of an organization can be interpreted using any of the three models; the model domains are not mutually exclusive. The challenge to model users is to determine which model would be most

helpful to them, given their task and their perception of the decision situation. Similarly the domains of usefulness of the organizational design paradigms outlined earlier are not mutually exclusive. In almost any actual design situation, each paradigm has some relevance. The following domain characteristics seem to favor use of the decision-making paradigm when designing organizations.

Hostile environments. Organizational designs should facilitate the conduct of important processes. If the environment is benign, then almost any alternative will do, and decision making is relatively unimportant since decision quality is relatively unimportant. If the environment is threatening, as it is when competitors are strong or when resources are scarce, then decision quality is important and the organizational design should facilitate the making of high quality decisions.

Complex environments. All else equal, an organization's decision situations are more complex when the organization's environment is more complex--when it contains more components with more interdependencies. More complex decision situations require organizational designers to provide for or allow for more types of expertise and consideration of more criteria, i.e., the situations require more structural differentiation. This in turn requires that organizational designers create decision processes and structures that integrate the differentiated units or their outputs (Lawrence and Lorsch, 1967).

Turbulent environments. All else equal, design should facilitate frequently occurring tasks. Since turbulent environments (fast-changing environments of low predictability) require more frequent decision making,

organizations in such environments should have designs that attend to this need.

We noted earlier that the major assumption of the decision making paradigm is that decision making is the organization's central activity. This assumption is more likely to be valid in environments such as those just noted; it is likely to be valid in post-industrial environments (Simon, 1973, pp. 269-270; Huber, 1984, pp. 933-934). Wherever the assumption is not valid, for example within organizational components so buffered from uncertainty that few or no judgments are exercised with respect to matters affecting organizational performance, then the paradigm has little applicability.

Related to this last argument is the argument that in fast-changing, highly unpredictable environments, planning, and therefore organizational design, is of little use, and organizations should instead rely on flexibility to respond to whatever environmental demands befall them (Sutherland, 1975; Ackoff, 1981; Kanter, 1983). Even if this argument is valid, it does not preclude the need for decision making. To the contrary, it heightens the need for a well-organized, fast-responding decision-making structure for swiftly deciding upon the organization's response (Smart and Vertinsky, 1977).

Hierarchical Level

Most applications of the paradigm's major concepts that we have described are at the operations level. It is important to note, however, that the paradigm is especially applicable at the organization's strategic management level where decision making is so clearly a central activity. Of course at the strategic level the phrase "central activity" must be interpreted less as "frequent activity" and more as "critical activity."

Strategic decisions may be infrequent, but the building and maintaining of the supporting infrastructure (the "decision processes", "information sources", and "structural forms" noted above) is an ongoing organizational design and redesign process (c.f., Huber, 1984, pp. 945-947).

3. Some Conceptual Boundaries

Theories, models and paradigms are often defined as much by what they are not as by what they are. In this section we identify four literatures to which the decision-making paradigm is related. In a sense these literatures help define the decision-making paradigm's conceptual boundaries. In another sense they are antecedents to the paradigm. Certainly they preceded the paradigm as it is presented here, and they were instrumental in the maturation of our thinking in this subject. On the other hand, neither the existence nor use of the decision-making paradigm depends on the existence of these literatures. Rather they and the paradigm are complementary.

Organizational Design

For an overview of the organizational design literature and its development, see Lewin and Huber (1986). The paradigm draws on this literature, and thus indirectly on the organization theory literature, as sources of insight into the nature of and need for the major concepts and applicable domains discussed in Section 2.

Organizational Decision Making

The decision-making paradigm addresses the issue of how organizations should be designed if their central activity is making decisions. Related to this, but in contrast to it, is the organizational decision-making literature that deals with how organizations actually make decisions and how their decision-making behaviors affect decision-outcomes. In order to give

more insight into the nature of this literature, we briefly highlight some of the better-known subtopics and works.

The "Carnegie School" led the way in studying organizational decision making with a series of case studies conducted during the 1950's and 1960's. The results of the earlier studies are summarized in The Behavioral Theory of the Firm (Cyert and March, 1963) and built, to some extent, on the earlier conceptual work, Organizations (March and Simon, 1958). Later studies used process models of organization decisions to evaluate and extend the Behavioral Theory of the Firm (Weber, 1965; Gerwin, 1969; a, b; Carter, 1971) or to gain insight into the variability and complexity of the organizational decision-making process (Mintzberg, Raisinghani, and Theoret, 1976).

In a further attempt to enrich our understanding, Allison (1969, 1971) described three models of organizational decision making, the Rational Actor Model, the Political Model, and the Bureaucratic Process Model, and used them successfully to interpret the Kennedy administration's handling of the Cuban missile crisis. Hah and Lindquist (1975) "tested" these models by retroactively attempting to use them to interpret the Truman administration's handling of the steelworkers' strike during the Korean War, and found them useful but less differentiable than had Allison. These studies are among the few where alternative models or paradigms were compared for their usefulness.

The idea of the Garbage Can Model of organizational decision making (Cohen, March, and Olsen, 1972) enriched our understanding of organizational decision making by introducing the random nature of the decision making process in many contexts, and seems to be a useful interpretive tool in many instances (March and Olsen, 1976). Other perspectives were also used to

examine and interpret the nonpredictability of the process (Lindblom, 1959; Witte, 1972; Mintzberg, Raisinghani, and Thoret, 1976; Anderson, 1983). More recently power and politics have received increased attention as variables affecting organizational decision processes (Pettigrew, 1973; Pfeffer and Salancik, 1974; Madison, Allen, Porter, Renwick, and Mayes, 1980; Zif, 1981; Shukla, 1982). No doubt other perspectives will appear in the organizational decision making literature as researchers build upon and extend the work of their predecessors.

The primary relationship between the organizational decision making literature and the decision making paradigm is that this literature serves as a source of insight into the need for and nature of the major concept of "decision process characteristics." We note also that because the paradigm is a design paradigm it focuses on intended processes, whereas the organizational decision-making literature focuses on emergent processes.

The Information Processing View of Organizations

In the past decade organizational scientists have given increasing attention to the notion that it is useful to view organizations as information processing systems (Tushman and Nadler, 1978; Knight and McDaniel, 1979). Some have examined the determinants of effectiveness of organizational communication and information processing systems (c.f., Huber 1982). Others have focused on designing organizations so as to enhance information flow (Wilensky, 1967; Simon, 1973; Galbraith, 1974; 1977) or information interpretation (Daft and Huber, 1986; Daft and Lengel, 1986). Of particular interest for our purposes is the work of Marschak and Radnor (1972) and Galbraith (1974; 1977) that focused on designing organizations as information systems for supporting organizational decision making. Empirical work that has used the information processing view of

organizational design to structure research efforts includes the work of Tushman and Scanlan (1981) on boundary spanning and that of Kmetz (1984) on complex workflow.

Clearly this literature could serve as a basis for formalizing an information processing paradigm of organizational design. If such a paradigm were set forth it would have features that overlap with those of the decision-making paradigm. To attain completeness it would also address the dysfunctions of organization communication systems (Campbell, 1958; O'Reilly, 1978) and the variety of organizational activities served by information, e.g., decision making, decision implementation, internal control, and maintenance of relations with external constituencies.

The decision-making paradigm differs from the yet-to-be-formalized information-processing paradigm in (1) its focus on decision making as the central activity to be supported through organizational design and (2) its view of information processing as one of several decision-support functions rather than as the organization's central activity. Treating organizations as information-processing systems rather than as decision-making systems runs the risk of creating structures and processes that maximize the effectiveness of the information-processing function at the expense of the decision-making function. We will develop this point with examples in Section 4.

There are two important relationships between the literature on the information-processing view and the decision-making paradigm of organizational design. One is that those items from the literature which focus on designing organizations as information systems for supporting decision making (c.f., Marschak and Radnor, 1972; Galbraith, 1974, 1977) provide guidelines that in some cases coincide with organization design

guidelines that follow from the decision-making paradigm. The other important relationship is that the literature on the information processing view of organizations serves as a source of insight into the nature and need for the major concept of "primary information sources."

Organizational Design and Technologically Supported Information Systems Design

A number of conceptual and prescriptive articles advance the perspective that the designs of management information systems and decision support systems should be compatible with the structures and processes of the organizations in which these systems reside. The articles tend to contain guidelines for putting this perspective into practice, guidelines based on experience and insight rather than on empirical studies. This is to be expected, given the youthfulness and dynamic nature of information systems technology.

The classic article by Ackoff on "Management Misinformation Systems" (Ackoff, 1967) was perhaps the first to make highly visible the need to develop MIS that fitted the organization's decision and control systems. Another article critical of the incongruity between organizational needs and the then-current information systems technology was Dearden's "MIS is a Mirage" (Dearden, 1972). Pieces more explicit in their approaches for designing information systems suited to the organization's processes have appeared in the last decade (c.f., King and Clelland, 1975; Markus, 1984).

This body of literature focuses primarily on designing technologically supported information systems that are compatible with existing organizational structures and processes. It seems that pieces focusing on the simultaneous design of (1) organizations and (2) their technologically supported information systems would be a useful complement

to this literature (Huber and McDaniel, 1986). It also seems that more empirical studies such as those of Huber, Ullman and Liefer (1979) and Carter (1984) examining relationships between imposed technologically supported information systems and emergent organizational structures and processes would be useful.

The literature concerning technologically supported information systems is related to the decision-making paradigm in that it provides some insights into the nature of technologically supported information systems that may facilitate organizational decision making. It does not, however, provide insights into the organizational structures and processes that facilitate decision making. In addition, its focus on technologically supported information systems leaves unaddressed design issues associated with traditional information systems (c.f., Wilensky, 1967; Mackenzie, 1985).

4. Design Guidelines

The purpose of this section is to further elaborate on the nature of the decision making paradigm. We attempt this by describing organizational design guidelines that follow from the paradigm's major assumption and concepts. This is not to say that certain of the guidelines do not follow from other paradigms, perspectives, or literatures as well, or even from common sense, just as research hypotheses sometimes follow from more than one theory or literature, or from common sense. For a design guideline to follow from the paradigm does not mean that it must be unique to the paradigm, rather it must (1) emphasize the organizational effectiveness criterion of maximizing decision quality and (2) employ a major concept of the paradigm as described in Section 2. Some of these guidelines may appear "obvious" given these two conditions, i.e., given the paradigm. Making such

guidelines obvious is, of course, a purpose of the paradigm! Other paradigms would make other guidelines "obvious." The guidelines chosen for discussion deal with the design of decision units, sensor and message handling units, and decision management units.

Designing Decision Units

Organizational members and groups of members make decisions on behalf of their organizations. When acting in this capacity they are called decision units. The decision-making paradigm calls for conscious design of these units and their relationships. The design guidelines related to decision units are the direct consequence of considering the organizational properties of centralization, specialization, and flexibility, and how the optimum levels of these properties would be determined using the decision-making paradigm.

Centralization concerns the dispersion of authority in the organization. If authority is closely held, the organization is said to be more centralized; if authority is diffuse, the organization is described as more decentralized. In many contexts the issue is one of where in the organizational hierarchy the authority to make decisions is located. Depending on the relative importance of the designer's goals, this point in the hierarchy might be very high or very low. For example, if a high-level administrator/designer seeks power or has little trust in her subordinates' decision-making ability or predeliction, she will delegate very little authority and thus design a centralized organization (Vroom and Yetton, 1973). If, in contrast, an administrator/designer wishes to maximize job satisfaction of subordinates through job enrichment, he will delegate authority as far down in the hierarchy as he can find capable subordinates (Szilagyi and Wallace, 1983, Ch. 5). Clearly the complexity of most real

situations requires trade-offs and compromises in order to choose a level in the hierarchy to which to assign the authority for making a given decision or type of decision.

What if the designer is interested in maximizing the quality of organizational decisions? How then should the optimum location in the hierarchy be determined? Use of the decision-making paradigm leads to the following guideline:

Guideline 1 - Assign decision making authority to the hierarchical level that minimizes the combined costs of lack of information about (a) the problem situation, (b) the organization's overall situation, and (c) the appropriate organizational policy.

The nature of the analysis associated with Guideline 1 is shown in Figure 1.⁵ As shown, information specific to the problem situation tends to be lower in the hierarchy while information about the overall organizational state or condition tends to be higher in the hierarchy, as does information about the appropriate organizational policy to use. From Figure 1 we see that the use of Guideline 1 creates decentralized organizations when the quality of decisions is more sensitive to problem-specific information, and creates centralized organizations when decision quality is more sensitive to the organization's overall situation or to the appropriateness of the policy used. Guideline 1 deals with an issue examined by many organizational scientists. It may be regarded as an extension of March and Simon's (1958, p. 165) concept of information absorption. Vroom and Yetton's (1973) discussion of shared authority, Marschak and Radnor's (1972) analysis of teams, or Galbraith's (1974; 1977) approaches for distributing information. And, of course, it follows from the decision-making paradigm.

Specialization concerns the degree to which different organizational units perform different functions. All else equal, if an organization is highly specialized the scope of responsibilities within units is also small, and thus the level of knowledge and skill required for a given person or unit to fulfill the limited set of responsibilities is low. This reasoning underpins the concept of division of labor articulated by Adam Smith in the context of manufacturing (Smith, 1793). But how would the appropriate level of specialization in an organization be determined using the decision-making paradigm?

There are two answers to this question. One follows from the work of Duncan (1973). Duncan found that for organizations in complex environments, organizational effectiveness was positively associated with the use of different decision-making structures (different decision unit membership configurations). Organizations that used different structures for addressing different types of problems were more effective than organizations that used the same structure regardless of the problem. Duncan also found that use of different structures had no effect on organizational effectiveness for organizations in simple environments. Evidently the variation among problems must be high (as would be the case in a complex or highly varied environment) for the association between organizational effectiveness and the use of specialized structures to be significant. Extrapolating from Duncan's work, the decision-making paradigm calls for application of the following guideline:

Guideline 2 - Create a degree of specialization among decision-making units that is commensurate with the complexity of the decision situations encountered.⁶

This guideline encompasses both the ad hoc creation of structures (units or teams) and the a priori design of structures for anticipated decision situations.

Guideline 2 does not directly address the overall degree of specialization in an organization; rather it focuses on specialization for decision-making purposes. It does, however, address the general property indirectly. In order to create specialization among decision structures (to have variability of information across decision units), the organization must have variability of information among its members--if all members were alike then decision units could vary only in their processes or in the number of (identical) members they contained. Therefore Guideline 2a:

Guideline 2a - Create a degree of specialization among potential decision unit or team members commensurate with the required variety of decision units or teams.

Thus, aside from the degree of specialization required to efficiently produce goods or services, the organization must maintain a degree of specialization for decision-making purposes. An interesting conclusion follows from this fact and the fact that the number of organization members is generally related to the degree of specialization: given the major assumption of the decision-making paradigm--that decision making is the central organizational activity--if the organization's size must be reduced to the point that units or personnel with unique specialization must be eliminated, the reduction in personnel must not be made in the decision units but rather in the production units!

Guideline 2b - If the degree of specialization must be reduced, maintain specialization among decision unit members at the expense of production unit members.

The last basic property to be dealt with is flexibility.

Flexibility refers to the ease with which the organization's structures and processes can be changed.⁷ What guidelines does the decision-making paradigm provide with respect to establishing organizational flexibility?

One guideline that responds to this question follows from the thinking summarized in Figure 2. The reasoning associated with cell 1 of the figure is that the nature of routine decision making will permit learning and, if the learning is codified and directions for its use are specified (as it would be if the decision process were made rigid), then decision quality would tend to be routinely high. In contrast, if the outcome of the learning is not codifiable and specifiable for use, decision quality would not be routinely as high; thus cell 2 is scored low. In cell 3, the rigid nature of the decision process will not permit the flexibility necessary to deal effectively with non-routine decisions, and so decision quality will tend to be low. In contrast, when flexibility is high, non-routine decisions will tend to be dealt with on the basis of their particular nature rather than with pre-established processes and rules that may not be appropriate; thus decision quality in cell 4 is scored high. Guideline 3 follows from this reasoning.

Guideline 3 - If both routine and non-routine decisions must be addressed, create and formalize a dual structure, one with rigid processes for routine decisions and the other with flexible processes for non-routine decisions.

How the two structures should be linked, e.g., whether the rigidly structured units should be embedded within the flexible structure or vice versa, is a matter for future research.

B. Designing Sensor Units and Message Handling Units and Systems

Sensor units directly access data about the organization's internal conditions and external environments. Message handling units receive messages from various sources and send messages to various destinations. A key aspect of designing both sensor and message handling units is to regard their central activity as one of making decisions (like interpretation decisions, routing decisions, summarizing decisions, prioritization decisions, and modification decisions). The quality of these decisions is a key determinant of organizational effectiveness, as the messages that are transmitted ultimately affect the choices and decision-implementation activities of other organizational units. Among the guidelines that follow from these concerns and from the decision-making paradigm are the following.

Guideline 4 - Ensure that sensor and message handling units make appropriate decisions concerning nonroutine or unanticipated messages.

Implementing this guideline would involve designing and implementing appropriate decision rules, training procedures, and reward systems. The guideline emphasizes the contrast between routine or anticipated messages on the one hand and nonroutine or unanticipated messages on the other. We of course assume that appropriate policies, rules, procedures, and reward systems will be established for routine and anticipated messages, but seldom do we see such efforts directed toward ensuring appropriate treatment of unusual (and often critical) messages.

Guideline 5 - Minimize the number of sequential links in communication chains.

Both delays and distortions in message handling reduce decision quality, and both are positively associated with the length of communication chains. One approach to increasing the likelihood that decision making

units will receive information with minimum delay or distortion is to employ communications networks and protocols that allow organizational units to "rifle-shoot" messages to (almost any) other units; this certainly minimizes the length of the communication chain. A potential problem with this approach is that decision-making units may become overloaded with messages, as the intervening layers of units whose role was to screen and condense messages will be bypassed. Consequently, when implementing Guideline 5 organizational designers must also implement Guideline 6.

Guideline 6 - Ensure that message-handling systems buffer decision-making units from overload.

This guideline requires that units permitted to directly address decision units be well educated about the nature of events and information that are potentially important to decision makers. It suggests designing reward systems that encourage message handling units to "package" messages in forms useful to decision units rather than simply transmitting or condensing messages in a prescribed manner, and perhaps even designing reward systems that encourage units to forward noncritical messages when the workload of the decision unit is light.

In some cases, implementation of Guideline 6 may require that communication chains be lengthened. Not all messages should be rifle-shot. Message-handling units adjacent to a message-receiving decision unit will tend to be more qualified to make decisions concerning the appropriate modification and prioritization of messages for the decision unit than will message-handling units further away (in an organizational sense) whose responsibilities include message dissemination to many decision units. Thus in many cases such "message-customizing" units should be incorporated into

the chains and networks that handle messages moving from sensor and lower-level message handling units to decision units.

To the extent that Guideline 5 and 6 are contradictory, a least-cost solution is called for--one that minimizes the overall costs of decision quality decrements associated with the message-handling system. To take this idea to its logical conclusion, we set forth Guideline 7.

Guideline 7 - Maximize the performance of the decision making system as contrasted with the information processing system.

An example application of Guideline 7 would be to establish message-handling rules that optimize the timeliness of messages for decision-making purposes, rather than rules that simply minimize message-handling delays. Another example also follows from the above discussion -- implement reward systems that encourage message-handling units to package messages in forms useful to decision units, rather than simply packaging the messages in a prescribed and reliable manner or, worse still, packaging them in forms that minimize the message-handling unit's processing and transmission costs.

C. Designing Decision Management Systems

In most situations, decision processes take their form as a consequence of loosely connected subprocesses, or are otherwise emergent rather than planned (Allison, 1969; March and Olsen, 1976; Mintzberg, Raisinghani, and Thoret, 1976). In direct contrast, the decision-making paradigm calls for the management of decision-making processes, since these are regarded as central activities that should not be left to chance.

Guideline 8 - Formally decide what to decide.

Known problems are like known volcanos, they are not all of immediate concern--some are hotter than others. The decision-making paradigm calls for a formal review of candidate problems and for a meta-decision process

that selects those to be acted on. It requires that a decision about decision priorities be made as carefully as decisions about action priorities. This guideline is a normative formalization of what early research showed to occur in an emergent manner with organizational units under load (Meier, 1963; Driver and Streufert, 1969). The process is explicitly enacted in organizations whose assigned function is decision making, e.g., state legislatures and appellate courts.

Guideline 9 - Manage decisions as projects.

This guideline can be made operational by adopting, with only minor modification, project-management techniques for managing the production of tactical and operations-level decisions. For example, at the planning stage the decision unit's use of PERT networks would facilitate identification of (1) needed activities such as obtaining particular information, (2) needed resources such as experts, new computer programs, and authorizations from top managers, (3) precedence and temporal relationships among these activities, thereby contributing to the scheduling of meetings, people, and analyses, and (4) the times required to make decisions of various qualities, (decisions that do or do not contain various quality-enhancing activities in the PERT network). Similarly, the "technology transfer" of the more behaviorally based Program Planning Model (Delbecq and Van de Ven 1971; Van de Ven and Koenig, 1976) from its primary arena of application, community-program planning, seems readily applicable to managing the production of strategic decisions.

The efficacy of PERT and CPM is well known, and what empirical research we have on the matter indicates that the Program Planning Model is also an effective management technology (Van de Ven, 1980). It appears that process-management technologies such as these could be readily transferred

to the organizational decision making context, and it is likely that future demands will lead to the development and use of technologies specifically designed for decision-process management. Thus the availability and adoption of decision-process management technologies at the decision-unit or decision-project level seems assured. The question then becomes, in what manner should the overall flow of organizational decisions also be explicitly managed? In particular, should we design a centralized control system?

It seems that formalized and centralized management of decision-making resources is inappropriate for most organizations. The partially uncontrollable demands for decisions of quite varying natures cause agreed-upon priorities to shift, resources to be reallocated, and schedules to be altered. In addition, the novelty of many decisions forces organizations to create (rather than select) solutions, thus leading to the cycling and looping documented by Mintzberg, et al, (1976). Thus centralized, mechanistic management of the overall flow of the organization's decisions is generally impractical. It seems more practical to create structures and processes that facilitate (1) management-by-exception monitoring of the progress of decision projects, and (2) allocation of decision-related resources through a problem-solving or negotiation process similar to that used in matrix organizations.

Guideline 10 - Establish organizational reward systems that reward decision units for the quality of their decisions.

As before, quality is to be broadly defined to include timeliness, acceptability, implementability, etc. It is reasonable to reward performance on the organization's most critical function. Although this guideline seems commonsensical, it is often not followed. For example,

appellate courts and medical practice review boards focus on punishing poor decisions rather than rewarding good ones, and most organizations tend to reward or punish decision makers based on the outcomes of decisions rather than on the quality of decisions. Reward systems established in accord with this guideline might include rewards for the quality of decision outcomes, but might also include rewards for the quality of the problem identification process, the choice-making process, the design of the implementation and monitoring process, and even rewards for the to-be-used learning that took place as a result of the decision-making endeavor.

5. Some Concluding Comments

Current and future organizational environments are and will be more characterized by complexity and turbulence than were earlier organizational environments. As a consequence, organizations are and will be required to make more decisions, and decisions of greater timeliness, acceptability, implementability, and technical and economic effectiveness. In short, decision making is an important organizational function and will become even more important. The organizational design paradigm described here responds to the need to design organizations as if their central activity were decision making.

Undoubtedly the paradigm will be further developed and refined through research and through evaluations of its application. Such efforts will be useful to organizational scientists, and particularly useful to managers actually engaged in designing and redesigning organizations. Of special interest to organizational scientists will be research that more closely examines the relationships of the paradigm with the literatures on organizational design, organizational decision making, and the information processing view of organizations, and the need for compatibility between the

(organization's design and the design of its technologically supported information systems. Of special interest to managers will be research that identifies and verifies additional design guidelines.

FOOTNOTES

- ¹We are using the word paradigm in a broad sense to mean a codification and formal explication of a perspective on a field. This use is not incompatible with its use in the behavioral sciences. Consider, for example, the following definition (parenthetical inserts are the authors'). "Paradigm, a collection of the major assumptions, concepts, and propositions in a substantive area (e.g., organizational design). Paradigms serve to orient research and theorizing in an area, and in this respect they resemble models (Dushkin Publishing Group, 1974). In recent years the term has been used to refer to elaborations of perspectives or frameworks, such as A Paradigm for Information Systems (Ein-Dor and Segev, 1981) and "the interpretive paradigm presents the view that organizations are socially constructed systems of shared meaning" (Smirich, 1983, p. 221).
- ²These paradigms are not necessarily mutually exclusive in application; all could be used in designing the same organization. Nor are the paradigms necessarily incongruent, (for example, the organizational audit and analysis approach (Mackensie, 1985) is a technology for organization design which evolved from theory about group structures and which clearly is based on applying both the accountability/authority and workflow paradigms).
- ³For a thorough examination of the subject of organization effectiveness criteria, see Lewin and Minton (1986).
- ⁴It is important to recognize (1) that service industries are replacing manufacturing industries and (2) that the workflow paradigm is applicable in service industries where mediating technologies (Thompson, 1967, pp. 16-17 are used. Its applicability in service industries using an intensive technology (Thompson, 1967, pp. 17-18) is more problematic, since the technology is less one of workflow within the organization than it is client treatment at the boundary of the organization (Mills and Moberg, 1982). It is also important to recognize that functional units other than manufacturing, such as marketing and finance, have their own technologies, but the applicability of the workflow-paradigm to the design of such units has received relatively little investigation. We suspect that such units are more frequently designed using the accountability/authority paradigm or the decision-making paradigm.
- ⁵If, in contrast to the curves shown, the component cost curves were such that the combined cost curve was concave downward and not irregular, the optimum level for locating decision-making authority would be either at the bottom or at the top of the organization, depending on the relative height of the intercepts.
- ⁶As can be seen, this guideline is a special case of Ashby's Law of Requisite Variety (Ashby, 1956).

7 Organizational theorists may be surprised that we choose to deal with flexibility rather than the related property of formalization. An example may aid our explanation: In some situations it may be appropriate for an organization to formalize its efforts to be informal, adaptable, and flexible (c.f., Huber, 1984, pp. 940-941). If the efforts are successful, if informality is maintained through formalization, does the organization possess high or low formalization? We choose to delegate further discussion of this issue to less-space-constrained works (c.f., McKelvey, 1982) and to discuss instead an organizational property that is more central to the decision-making paradigm, namely, flexibility.

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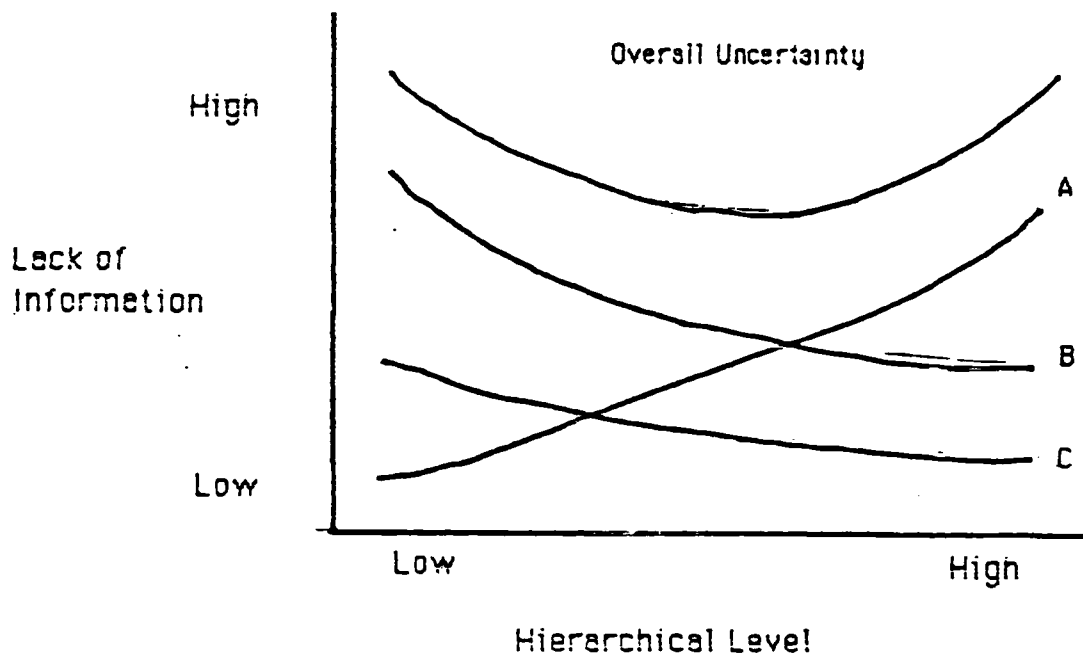
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- A. Cost due to lack of information about the "situation."
Usually greater at higher organizational levels.
- B. Cost due to lack of information about organizational policies.
Usually greater at lower organizational levels.
- C. Cost due to lack of information about overall organizational situation.
Usually greater at lower organizational levels.
- D. Overall cost due to lack of information.

Figure 1. Costs of Decision Quality Decrements Caused by Lack of Information

		<u>Organizational Processes</u>	
		Rigid	Flexible
<u>Decision Type</u>	Routine	High 1	Low 2
	Non-routine	Low 3	High 4

Figure 2. Quality of Organizational Decisions

EXPLOITING INFORMATION TECHNOLOGIES TO DESIGN
MORE EFFECTIVE ORGANIZATIONS*

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EXPLOITING INFORMATION TECHNOLOGIES TO DESIGN
MORE EFFECTIVE ORGANIZATIONS

Abstract

Organization design have historically been constrained, generally implicitly, by the state of available information technology. Information systems themselves are generally constrained to fit within the current designs of the organizations implementing them.

It is important that we change this state of affairs. When new information processing technologies are being considered, information systems designers and line managers must consider not only what benefits the technologies could provide if they were superimposed on the existing organization, but must also think creatively about what benefits the technologies could provide through facilitating the introduction of more effective organizational structures and processes. What organizational design options are opened up with evolving and forthcoming information processing technologies? We will address this question in this chapter, and provide guidelines for exploiting information technology to design more effective organizations.

EXPLOITING INFORMATION TECHNOLOGIES TO DESIGN
MORE EFFECTIVE ORGANIZATIONS

1. Introduction

Any significant advance in information technology seems to lead eventually to recognition and implementation of new organizational design options, options that were not previously feasible, perhaps not even envisioned.¹ Without telephones corporations could not have become as large as they have; without radios military units would be constrained to structures and tactics different from those they now use; without computers the processes for managing airline travel would be different from what they are. The list could go on and on.

Such developments do not take place rapidly, however; a considerable delay generally occurs between when a new information technology is first used to make current organizational forms more efficient and when it is used to facilitate introduction of new and more effective organizational structures and processes. Among the reasons for this often costly delay is the fact that little effort has been directed at identifying how improved information systems can affect organizational structures and processes. In an attempt to rectify this state of affairs, we identify in this chapter organizational design guidelines for exploiting evolving and forthcoming information technologies to make feasible new organizational structures and processes.

It is interesting to observe that, just as organizational designs have been (and still are) constrained by the state of information technology, information systems themselves are generally constrained to fit within the

current designs of the organizations implementing them. From an administrative perspective this is shortsighted, since the existing structures and processes are themselves consequences of out-of-date information processing technologies; they are out of date at the very least with respect to the new information system being implemented. As Dennis Tsichritzis noted in Chapter 2, after adopting the hardware and software of office automation, many organizations continue to employ the same structures and processes that their managers implemented when the organization was constrained to telephone, messenger service, and typewriter technologies. Thus we find that currently envisioned information systems tend to be constrained by current organizational designs and, at the same time, potential organizational designs tend to be constrained (by our lack of imagination) to those designs appropriate for out-of-date information processing technologies!

It is important that we change this state of affairs. When new information processing technologies are being considered, information systems designers and line managers must consider not only what benefits the technologies could provide if they were superimposed on the existing organization, but must also think creatively about what benefits the technologies could provide through facilitating the introduction of more effective organizational structures and processes.² What are these benefits? What organizational design options are opened up with evolving and forthcoming information processing technologies?

We will address these key questions in Section 3 of this chapter, where we will also be more specific about what we mean by "evolving and forthcoming information processing technologies." First, we must address the issue of the need for change in organizational designs. Will change

occur? Will organizations be designed differently simply because new information technologies create new design options? Maybe not, at least not in many instances. For change to occur, for the organizational design opportunities provided by evolving and forthcoming information systems to be exploited, there must be more than a release from constraints. There must also be a need for change, there must be a need for new organizational structures and processes. Is there such a need? Will there be such a need? These questions we address in Section 2.

2. Need for New Organizational Capabilities

A variety of facts and interpretations of facts lead to the conclusion that future organizational environments will be characterized by more and increasing information, more and increasing complexity, and more and increasing turbulence (c.f., Naisbitt, 1982, and Huber, 1984a). In combination, these trends will pose qualitatively more demanding organizational environments. These environmental demands will have to be met, at least in part, by changes in organizational designs. To go beyond this generalization, to be more specific about the structures and processes appropriate for the future, we must consider more explicitly the nature of existing and forthcoming organizational environments.

Available Information--more and increasing

It is incorrect to interpret the Information Explosion as a "recent trend", as is commonly done. Consider, for example, scientific information. The first two scientific journals appeared in the mid-seventeenth century (de Solla Price, 1963). By the middle of the eighteenth century there were ten scientific journals, by 1800 about 100, by 1850 perhaps 1,000. Near the end of the 1970's estimates ranged between 30,000 and 100,000 (Bell, 1979).

Nor is this explosion likely to diminish in the intermediate future. Since information feeds on itself, we can expect that the absolute amount of information will continue to rise. That is, even when (or if) the rate of increase declines, the existing information base will be so large that absolute increases in units of information per unit of time will remain large throughout at least the first half of the next century and very likely far beyond that.

Of equal importance is the fact that communications and computing technologies will greatly increase the availability of whatever information is produced. Since these technologies are in their early stages, in terms of both effectiveness and adoption, we must also anticipate rapid increases in the availability of existing information as these information distribution technologies mature and become widely used. The increased adoption of information distribution technologies, superimposed on the geometrically increasing information base, will necessarily result in an information environment that is dramatically more munificent (or burdening) than is today's information environment. It is the generally unconsidered combination and interaction of these two phenomena that will cause the future information environment of organizations to be qualitatively different from what has been experienced in the past; in future organizational environments both the amount of available information and its absolute growth will be significantly greater than in the past.

Complexity--more and increasing

It is useful to view environmental complexity as having three characteristics: numerosity, diversity, and interdependence. Systems theory reminds us that these tend to be related to each other: "As the system's components become more numerous, they become specialized, with

resulting increased interdependence . . ." (Miller, 1972, p. 5). An examination of these characteristics and their relationships indicates that organizational environments of the future will necessarily be much more complex. Consider, for example, numerosity. Whether or not environmental components in general will become more numerous is unclear, in spite of current short-term tendencies for some types to increase. If some do, such as humans or corporations, our conclusion that organizational environments will be more complex will to some extent be confirmed. Aside from whether the actual number of components will be greater, however, it does seem clear that communications and transportation technologies will cause the "effective" number of environmental components to be greater.

The major increases in the complexity of future organizational environments will not, however, arise solely from or depend on increases in numerosity. They also will follow from increases in diversity and interdependence. New knowledge leads to increased diversity. The large increase in available information discussed earlier will lead to a large increase in environmental diversity, as it will enable individual environmental components, such as other organizations, to identify and exploit technological, economic, and social niches. Thus we can anticipate more and increasing specialization and diversity in the environment as a result of more and increasing information, whether or not there is an increase in numerosity.

Finally, consider interdependence. Specialization results in interdependence because as living systems specialize they give up certain capabilities (or do not achieve commensurate growth in certain capabilities) and must rely on other ecosystem components for the resources that they themselves can no longer provide. Thus the anticipatable increases in

specialization noted above will necessarily lead to increased interdependencies. In addition, potential increases in physical interdependence may lead to increases in societal interdependence (Mesarovic and Pestel, 1974; Kahn, Brown, and Martel, 1976). For example, possible increases in the ratio of demand to supply of certain limited resources (such as metals or croplands) may create interdependencies for future environmental components beyond those experienced today.

In summary: (1) the anticipatable large increases in information will lead to large increases in technological, economic, and social specialization and diversity; these increases may be facilitated by increases in the effective numerosity of environmental components, and (2) these large increases in specialization and diversity will lead to large increases in the interdependence among environmental components. These latter increases may be further aggravated by increases in the demand=supply ratio of certain physical resources. As a consequence of these arguments we conclude that in future organizational environments both the level of complexity and its absolute growth rate will be significantly greater than in the past.

Turbulence--more and increasing

Increased turbulence will follow from increases in the swiftness of individual events. We recall that organizational environments in the future will be characterized by more and increasing knowledge. This will cause many technologies to be more effective. An important consequence of these heightened levels of effectiveness will be that individual events will be shorter in duration. They will transpire more quickly. For example, improvements in R&D technology, in advertising technology, and in distribution technology will enable competitors to steal markets even more

quickly than they can today, and some high-technology military engagements will be subject to completion in a matter of moments. The role of geographical distance and even cultural differences as "time buffers" will be greatly diminished as improved communication and transportation technologies are implemented on a near-universal scale. Since shorter events permit more events per unit of time, the eventual effect of increased knowledge is increased turbulence. In combination, then, our earlier reviews of forthcoming increases in the number and diversity of societal components and in the growth of knowledge cause us to conclude that in future organizational environments both the level of turbulence and its absolute growth rate will be significantly greater than in the past.

Required organizational capabilities

What are the organizational capabilities required by the fact that future organizational environments will be characterized by more and increasing knowledge, complexity, and turbulence? Contingency theory, systems theory, and common sense tell us that for an organization to survive it must be compatible with its environment. When the environment changes to a state incompatible with the current organization, the organization may have available a variety of strategies including: (1) adapting to the changed demands, (2) moving to a different environment, (3) changing the environment to a more compatible state, or (4) relying on slack, loose couplings, or other buffers.³ Selection among these and other coping strategies require that decisions be made. The greater turbulence of future environments will demand that organizational decision making be more frequent and faster. The greater complexity of this environment will also cause decision making to be more complex (e.g., to require consideration of more variables and more complex relationships among these variables).

Some decisions will concern fairly radical changes in the technologies, processes, and structures that the organization employs. The heightened turbulence of environments will require that these organizational adaptations be more frequent and faster.

Organizations require information to decide when decisions and adaptations are needed, and decision makers require information to reach conclusions. The increased turbulence of future environments will cause organizational information acquisition to be more continuous, and the increased complexity will cause it to be more wide ranging. At the same time, however, the informational richness of the environment may create problems of overload, both on the organization's sensors and on the internal units that process messages from these sensors. This necessitates that organizational information processing be more directed.

In summary, the demands of future organizational environments will require that much more emphasis be placed on designing organizations so as to increase the effectiveness of their (1) decision making, (2) adaptation, and (3) information acquisition and processing functions. These ideas are summarized in Figure 1.

Insert Figure 1 about here

Clearly there is and will be a need for managers to change the structures and processes of their organizations. What structures and processes will be appropriate? What is the role of information systems in these structures and processes? Section 3 deals with these and related matters.

3. Guidelines for exploiting Information Systems to Design More Effective Organizations

We have inferred that evolving and forthcoming information systems and information technologies will facilitate the use of new and more effective organizational designs. Although the technical and futurist literatures have undoubtedly given most readers a sense of what these systems and technologies will be, it may be useful to be more specific about the particular systems and technologies that we envision as contributing to an increase in organizational design options. We first consider communications technologies, then computing technologies.

The nature of evolving and forthcoming technologies

With regard to communications technologies, we note two important facts: (1) today's systems are not nearly as friendly or as effective as they will be, and (2) the low level of adoption of some currently available systems is a consequence of their temporary unfamiliarity and high cost (much as was the case for word processors a half-dozen years ago or computers a decade ago). Electronic mail systems, voice-mail systems, radiophones and yet-to-be-discovered communication systems will be improved with new technological "generations." Portable phonelike devices will have voice-mail features, combining the real-time, access-enhancing capability of the portable phone with the message-recording and storage capability of voice mail. A large variety of devices will have combinations of text, graphics, and audio capabilities. The consequent increased accessibility to people, increased efficiency of communication, and increased timeliness of communication (all much more important in organizational environments of the

future) will cause these evolving and forthcoming communications systems to be adopted on a scale not greatly different from that of today's hardwired telephone systems.

Computing technologies are used both for storing and retrieving information, as in Management Information Systems, and for processing information to create new information, as in Monte Carlo simulation systems. In recent years we often find under headings such as Decision Support Systems (DSS) Expert Systems (ES), and artificial-intelligence-based Knowledge Systems (KS) -- these information technologies have been combined. In the future, the capabilities of these technologies will often appear in the same system and, in any case, will be far beyond what we find in their current, transitory, embryonic forms.

A number of points must be noted. One is that forthcoming DSS, ES, and KS will be extremely friendly. For example, they will be voice operable and will coach their users. The second point is that they will contain a great deal of information that was originally external to the organization. The third is that their information will be much more up-to-date than is that of current systems since it will not have had to pass through a hard-copy stage. Fourth, the systems will be much smarter, incredibly smarter, and in view of this and their friendliness will serve more as counselors than as file drawers. The last point is that they will serve in political, bureaucratic, and "garbage can" decision environments in addition to serving in more rationalized decision environments (c.f., Huber, 1981; Shrivastava, 1982).

Although there will be false starts and failures, as early MIS were false starts toward today's more successful MIS and DSS, it is clear that evolving and forthcoming information technologies such as those just

described will be much more helpful than those now available. Let us now consider how the capabilities of information systems employing such technologies can be exploited to design organizations suited to the organizational environments described in Section 2. Ultimately we seek organization design guidelines.

Effects of evolving and forthcoming technologies on decision making structures and processes

Changes in information technologies often lead to changes in an organization's structure or processes (Huber, Ullman, and Leifer, 1979; Carter, 1984). Here we note two changes that we expect to follow from the adoption of the advanced technologies just described and then two organization design guidelines that facilitate and exploit these changes in organizational structure and process.

As one change, we expect that the number of persons contributing to a decision from outside the formally appointed decision-making unit will be greater, as communications technologies will cause accessibility in time or distance to control involvement less and less. Thus, the diffuseness of influence on decisions will be greater. In effect, the boundaries of decision-making units will be fuzzier and more permeable.

A second change will follow from the fact that in the future decision-making units will obtain some of their information and analyses from very "friendly and smart" DSS, ES, and KS. While to some extent DSS, ES, and KS will update their knowledge by "reading" inventories and newspapers and will be self-teaching, the turbulence and changing complexity of future organizational environments will require that experts frequently be called in to update and upgrade the knowledge of these systems. Having thus contributed their knowledge, experts who otherwise would be contacted

directly by decision-making units will be "accessed" through the DSS, ES, or KS system. Thus the processes through which experts influence decisions will often be less direct.

How can we exploit these changes to create more effective organizations? One approach may be to help resolve a dilemma posed by the increasing complexity of organizational environments. While on the one hand the designers of future organizations will be motivated to increase the heterogeneity (and thus the size) of decision-making units in order to include people having various types of expertise and representing various constituencies, on the other hand efficiency considerations will cause the designers to resist this pressure to whatever extent is possible. Advanced information technologies will help resolve this dilemma by enabling the formal prescribed decision unit to access outsiders when needed, either directly via videophones, or indirectly through DSS, ES, and KS, rather than keeping the outsiders "on hand" as members of the formal unit. Thus formal decision-making units will be smaller in terms of personnel but greater in terms of information resources (smaller, that is, than would be the case if the decision-making units did not employ these advanced technologies). Since smaller units are less costly and also provide more satisfying work environments, it may be useful to employ the following organizational design guideline.

Guideline 1--Use advanced information technologies to increase the information available to decision making units while decreasing the heterogeneity and size of the units.

For a variety of reasons, increases in environmental complexity generally increase the need for organizational members and units to exchange information. Often this sharing takes place in meetings. Given higher

levels of environmental complexity, there will be pressure for the number of meetings in organizations to be greater. This pressure will be resisted strongly, however, since increases in the time spent in meetings require decreases in the time spent in other managerial or professional activities. We expect to see two approaches used to facilitate the increased information sharing required by increased environmental complexity, while at the same time minimizing the time spent in meetings.

As one approach, we expect behavioral scientists and individual organizations to develop and implement additional procedural technologies for increasing the efficiency and effectiveness of decision-oriented meetings (particularly technologies for designing solutions rather than thinking of or choosing solutions). Even though a good deal of development work has already been done and some adoption of the resulting "decision-group" technologies is occurring (c.f., Van Gundy, 1981), we expect that in the future, the increased need to exchange information will lead to a much higher density of application of such technologies.

As a second approach to facilitating increased information sharing, we expect that a significant increase in decision-group efficiency and effectiveness will be achieved by creatively integrating advanced information technologies into decision-group technologies. This has already occurred in a rudimentary way in the form of teleconferencing, video conferencing, and electronic-mail-enhanced Delphi studies for aiding distributed decision groups. Face-to-face meetings also are made more effective with marriages of information technologies and behaviorally based procedural technologies as when, for example, in the Nominal Group Technique each participant writes his or her ideas on an electronic pad and then transfers them to the "public screen" with the touch of a "send" button or

when ratings are forwarded and compiled electronically and displayed as histograms so that discussion can be directed in more fruitful channels (Huber, 1984b). As another example of how advanced information technology can facilitate information sharing, consider that the effectiveness of many decision-related meetings is considerably reduced when a difference of opinion develops about certain facts. With DSS, ES, and KS at hand, some of these differences of opinion can be resolved during the meeting and nearly instantaneously. Overall, it appears that information technology can speed the work of decision units and also, by increasing the effectiveness of information sharing, increase the quality of decision making and thereby reduce the number of problems that decision units must deal with more than once. By thus reducing the time spent in decision making, information technologies can reduce the number of units employed in decision making.

In summary, given the increasing need for more decision-group meetings and at the same time a considerable resistance to them, we expect organizational designers to employ the following organizational design guideline.

Guideline 2--Use advanced information technologies to increase the organization's decision-making productivity while decreasing the number of its decision-making meetings.

An organizational design guideline that is so common and commonsensical that we hardly recognize it in action is the following: When the work of units must be coordinated, assign these units under the same superordinate unit. The availability of advanced information technology suggests two variants on this guideline. One follows from the straightforward observation that the span of management, the number of people that can be managed and coordinated by one superordinate, is greatly affected by the

ease or difficulty of communication between the superordinate and those whose activities he or she controls. The improvement in communications attainable with advanced technology suggests the following guideline:

Guideline 3--Use advanced information technologies to increase the span of management without decreasing the effectiveness of managerial coordination.

Implementation of this guideline results in fewer managers, and thus conserves organizational resources.

Returning to the earlier idea that units whose work must be coordinated should be assigned under the same superordinate unit, we note that an organizational practice closely associated with this guideline is that many proposals from lower organizational levels must be "approved" or "authorized for action" or coordinated by higher levels. The delays in final decisions that result from this practice are notorious and are frequently brought to public attention by the media. A particularly interesting example of this practice was described by Shumway, Maker, Baker, Souder, Rubenstein, and Gallant (1975) in their analysis of the approval process for a research and development budget. The process took 22 months and involved authorizations at 7 hierarchical levels. Not surprisingly, some looping and negotiating takes place as levels attempt to share information.

The practice exists and is pervasive because each level has information that the next-lower level did not have, such as the appropriate priorities associated with competing proposals from horizontally adjacent units. In effect, the levels are specialized or differentiated by the decision rule or criterion that they employ; e.g., level 2 applies criterion B, level 3 applies criterion C, and so forth. With advanced information technology, however, more commonality of information across levels could be achieved.

Therefore more levels would be qualified (in an information possession sense) to employ any given rule or criterion and a well-informed decision unit or level could apply several specialized rules or criteria simultaneously. This means that fewer units or levels would be required to employ any given set of rules or criteria. Thus the following guideline becomes feasible:

Guideline 4--Use advanced information technologies to decrease the number of hierarchical units or levels necessary to approve a proposal without decreasing the number of criteria used to judge the merits of the proposal.

Effects of advanced information technology on organizational intelligence

Organizations are frequently viewed as information processing systems (Knight and McDaniel, 1979) or intelligence generating systems (Wilensky, 1967), and certainly a large part of what many organizational units attempt to do is to "get the right information to the right decision maker in the right form." Because, as we noted earlier, future organizational environments will require that organizations significantly increase their intelligence activities, we expect forthcoming organizational designs to include more units having organizational intelligence responsibilities.

Some of these units will be sensor units involved in information acquisition. These units will contribute to the organization's horizontal growth. Other, intermediate-level units will be involved in summarizing, interpreting, and selectively routing messages received from sensor units and ultimately destined for still higher-level units. The presence of these intermediate-level units is a mixed blessing. On the one hand their summarizing, interpreting and selective routing of messages greatly reduce

the information handling load of higher-level units. On the other hand, their efforts often lead to message delays and undesirable distortions (Huber, 1982). These delay and distortion costs could be greatly reduced with an organizational design that drew upon advanced information technologies to facilitate using the following design guideline.

Guideline 5--Minimize the number of sequential links in information processing chains.

One approach to using this guideline is to employ communications technologies that allow organizational units to "rifle-shoot" messages to (almost any) other units. A potential problem with the approach is that receiving units may become overloaded with messages, since the intermediate layers of units whose role it was to summarize, interpret, and selectively route messages will be bypassed. Consequently, when using this guideline, organizational designers must also implement Guideline 6.

Guideline 6--Ensure that sensor units are (1) attuned to the nature of events and information that are important to different organizational units, (2) provided with easily used guidelines and devices for distributing information that for them may be nonroutine, and (3) motivated to correctly screen, route, and "package" messages.

Effecting Guideline 6 will require organizations to take aggressive measures to educate all sensor unit personnel about the organization's current and anticipated goals, domains, structures, and processes. The purpose of these efforts will be not only to enhance employee motivation and esprit de corps, but also to enhance understanding and judgment about how to recognize and what to do with nonroutine information. Organizations will further augment this human learning with intelligent devices that facilitate making routing decisions and transmitting messages. Advanced information

technologies will support this effort; DSS-like directories will accept verbal descriptions of the event or information that their users see has possible importance, will use artificial intelligence to generate recommendations concerning where the information should be sent, and will activate the appropriate communication devices for conveying whatever messages the user authorizes. It is important to note that effective use of these devices depends on the ability of the human sensor to recognize significant events; the educational measures noted above are critical. Finally, organizational designers must put reward systems in place that encourage sensor units to take initiatives in seeking out appropriate message recipients while at the same time buffering potential units from information overload. Approaches to buffering might include packaging messages in useful forms rather than simply transmitting or summarizing them in a prescribed manner, or perhaps even forwarding messages when they will be most useful rather than as soon as possible.

Implementation of Guideline 5, qualified with Guideline 6, causes the organization to operate with a sparse message-handling network. It also reduces the message-handling workloads of units at intermediate levels in the hierarchy. With their workloads reduced, such units can be combined and made fewer. This conserves organizational resources. Thus we have Guideline 7, an elaboration of Guideline 5 and also of Guideline 6.

Guideline 7--Use advanced information technologies to decrease the number of organizational units without decreasing organizational effectiveness.

Potential effect of advanced information technology on the location of decision making authority

One of the tasks in organizational design is to determine the appropriate degree of centralization. Centralization concerns the dispersion of authority in the organization. If authority is closely held, the organization is said to be more centralized; if authority is diffuse, the organization is described as more decentralized. In many situations it is difficult to determine the level in the organization's hierarchy at which the authority to make decisions should be located. While the rational designer wants to minimize the combined costs of decision quality decrements caused by lack of information about (1) the problem situation, (2) the organization's overall situation, and (3) the appropriate organizational policy, it is generally difficult to determine the hierarchical level at which the combination of these three costs will be minimal.

As shown in Figure 2, information specific to problem situations tends to be lower in the hierarchy. In contrast, information about the impact of

Insert Figure 2 about here

various possible local choices on the overall organization's state or condition tends to be higher in the hierarchy, as does information about the appropriate organizational policy to use. Essentially the organizational designer wants to find the lowest point on curve D of Figure 2.⁴ Finding this level is difficult because it is difficult to determine the locus of curves A, B, and C. How can advanced information technology help the designer? Can it help determine the locus of the curves? Probably not. But it can make the curves flatter by making each of the three types of information more available; higher-level units can be more informed about local situations and lower-level units can be more informed about the

organization's overall situation and about organizational policy. The importance of this flattening of the cost curves is that flatter curves reduce the sensitivity of the combined costs to deviations from the optimum hierarchical level, as shown in Figure 3.

Insert Figure 3 about here

A second effect of such curve flattening is related to the first. Earlier we spoke of the desire of the designer to minimize the three costs associated with curves A, B, and C. In many situations, however, criteria other than minimization of these costs will operate to influence the location of decision making authority. For example, a powerful organizational member or a long-standing tradition may demand that the authority be located at some level or office other than that which is optimal according to the minimize-three-costs criterion. The adverse effect of this, in terms of decreased decision quality, can obviously be reduced by making the cost curve less sensitive to deviations from the optimum hierarchical level, and this can be achieved using evolving and forthcoming information technologies that distribute information more rapidly and in more usable forms. This reasoning suggests the following guideline:

Guideline 8--Use advanced information technologies to increase the range of hierarchical levels at which particular decisions can be made without increasing the costs of decision quality decrements caused by lack of information about (1) the problem situation, (2) the organization's condition, and (3) the appropriate organizational policy.

Implementation of this guideline allows the organization to locate authority at points that satisfy organizational constraints and objectives having to do with power distribution, logistical issues, and so forth and still not sacrifice decision quality to any significant extent.

4. Summary

The message of this chapter is that evolving and forthcoming information technologies should be used to facilitate creation of more effective organizational designs, rather than to make current designs more effective. The principal impediment to this use is our inclination to design information systems around existing structures and processes, rather than to think imaginatively about what the organizational design could be if it were not constrained by out-of-date information technology.

The chapter first examined the nature of future organizational environments and then examined the organizational capabilities that these environments will require of organizations. The chapter then described the nature of some advanced information technologies that can be used to help organizations achieve these required capabilities. The main section of the chapter discussed how these advanced technologies could be used to facilitate the use of new and more effective organizational designs. In particular it set forth eight guidelines for employing advanced information technologies to implement structures and processes that seem efficacious but would have adverse side effects if the technologies were not employed.

FOOTNOTES

- ¹We use the terms information technology and information system to mean any combination of equipment and procedures that facilitates the creation, acquisition, modification, interpretation, transmission, storage, or use of information. The term thus includes, for example, both computing and communications technologies. We use the term organizational design as a noun phrase to mean the structures and processes that organizational members use to achieve desired organizational outcomes, and as a verb to mean the processes used to choose or create the organization's design.
- ²The reader may want to consider a complementary strategy of integrating the designs of the computer-based information system and the organization based on the organization's information processing requirement (c.f., Specht and Robey, 1986).
- ³For those readers interested in more detailed discussions of these strategies, the following references may be helpful: (1) adapting to the changed demands (Shein, 1980; Porter, 1985); (2) moving to a different environment (Thompson, 1967; Miles and Snow, 1978); (3) changing the environment to a more compatible state (Weick, 1979); and (4) relying on slack, loose couplings, or other buffers (Galbraith, 1977; Weick, 1979).
- ⁴If, in contrast to the curves shown, the component cost curves were such that the combined cost curve was concave downward and not irregular, the optimum level for locating decision making authority would be either at the bottom or at the top of the organization, depending on the relative height of the intercepts.

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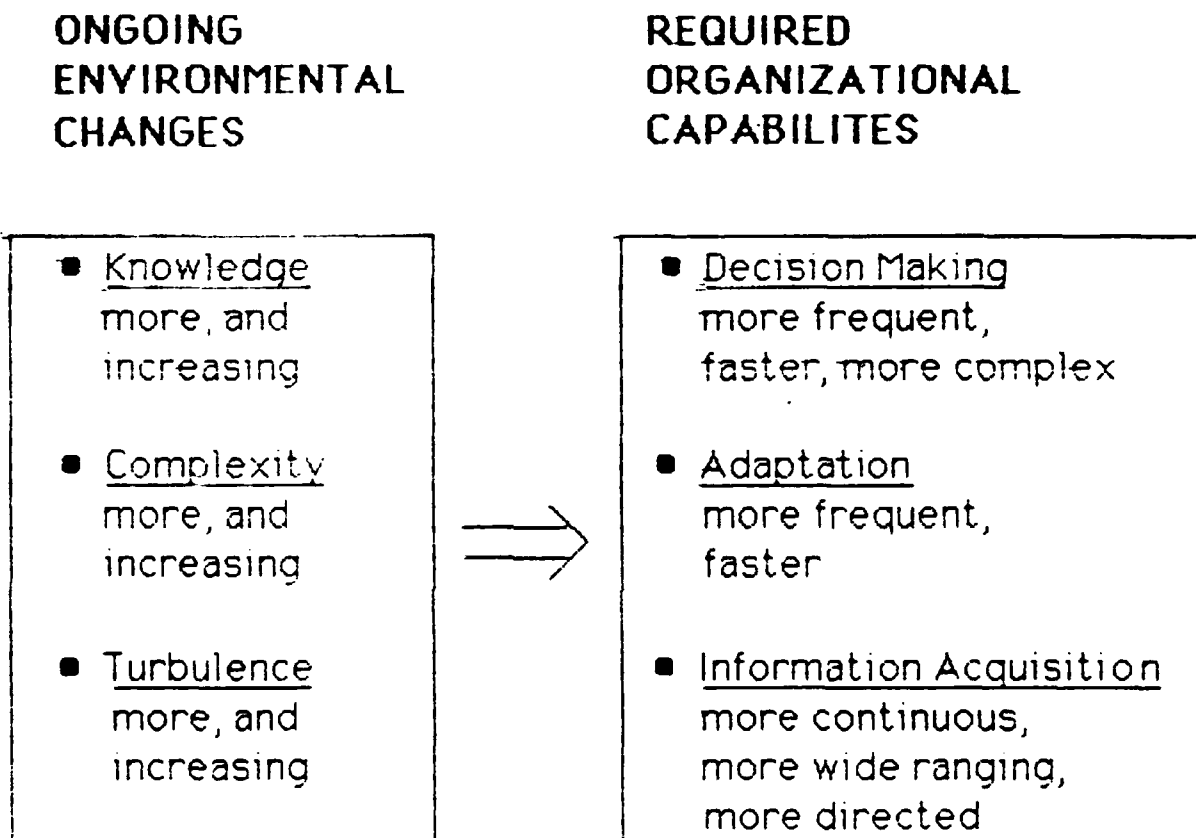
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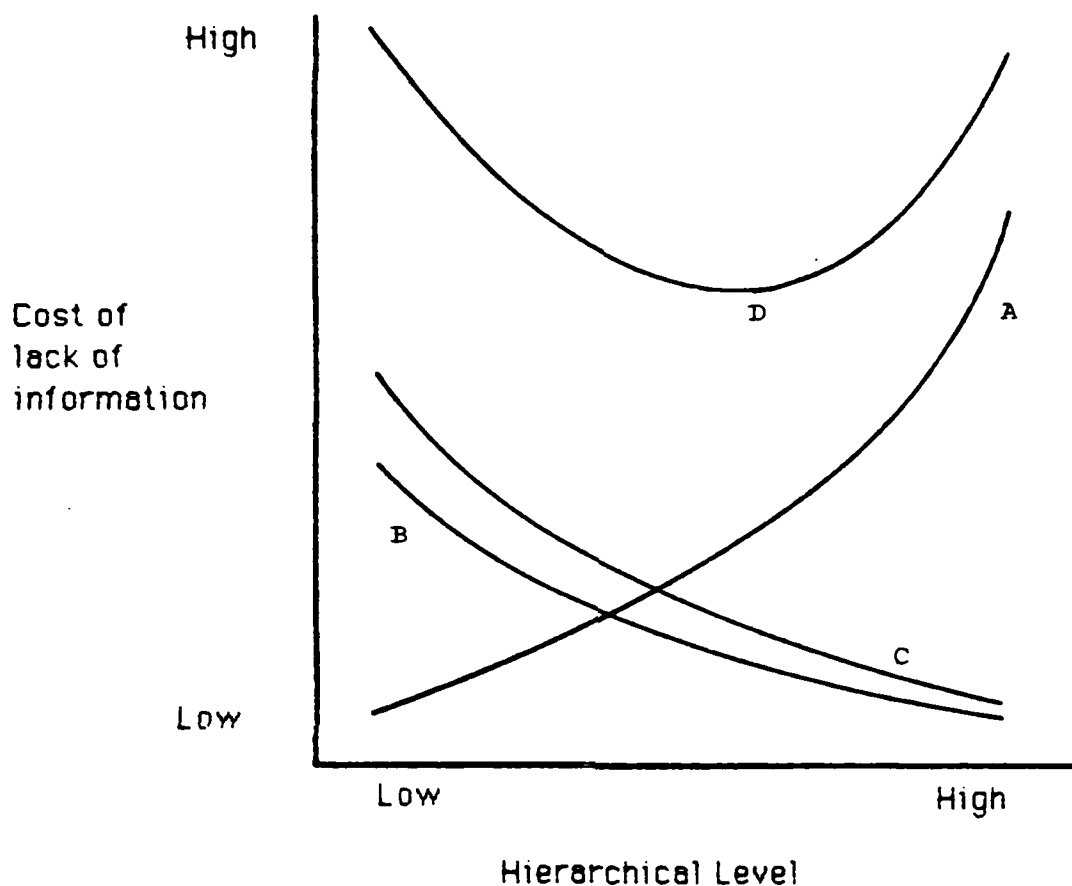
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Figure 1 - CAUSES OF REQUIRED CHANGES IN ORGANIZATIONAL CAPABILITIES



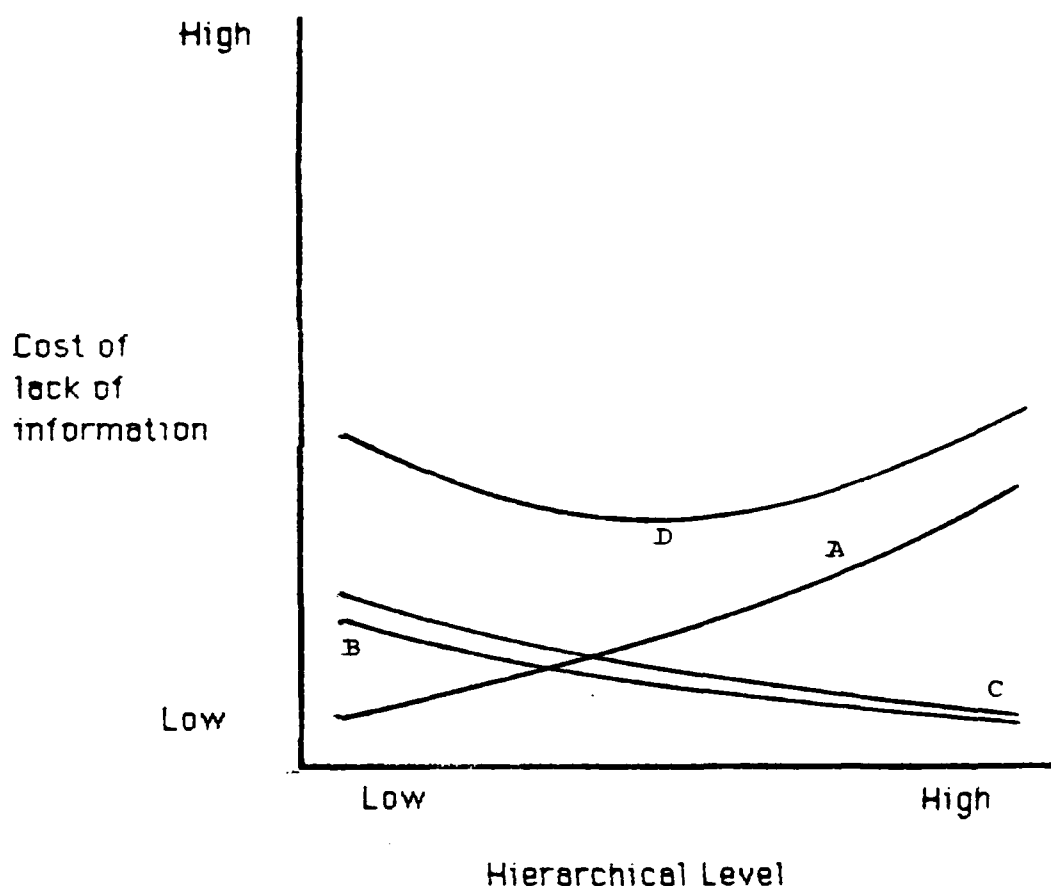
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Figure 2 Costs of Decision Quality Decrements
Resulting from Lack of Information



- A. Cost resulting from lack of information about the "situation." Usually greater at higher organizational levels.
- B. Cost resulting from lack of information about organizational policies. Usually greater at lower organizational levels.
- C. Cost resulting from lack of information about overall organizational situation. Usually greater at lower organizational levels.
- D. Overall cost resulting from lack of information.

Figure 3. Costs of Decision Quality Decrements
Resulting from Lack of Information



- A. Cost resulting from lack of information about the "situation." Usually greater at higher organizational levels.
- B. Cost resulting from lack of information about organizational policies. Usually greater at lower organizational levels.
- C. Cost resulting from lack of information about overall organizational situation. Usually greater at lower organizational levels.
- D. Overall cost resulting from lack of information.

THE SYSTEMS PARADIGM IN THE DEVELOPMENT
OF ORGANIZATION THEORY:
CORRECTING THE RECORD AND SUGGESTING THE FUTURE*

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Abstract

Two mistaken beliefs have repeatedly appeared in the organization theory literature concerning application of the systems paradigm to organizations. This paper identifies and corrects these beliefs. Three opportunities for using the systems paradigm to further the development of organization theory have been overlooked. The paper identifies these opportunities and suggests how they can be exploited. Finally, the paper notes that recent advances in organization theory could enrich the paradigm, making it more useful for organization research.

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In this paper we attempt to strengthen the field of organization theory by identifying mistaken beliefs and missed opportunities associated with the systems paradigm and its role in the development of organization theory.

The systems paradigm should not be confused with the more rudimentary systems concept--that systems are composed of interrelated components and that the properties of both the system and its components are changed if the system is disassembled in any way. The paradigm is more elaborate and includes the concepts, findings and beliefs associated with the literatures that concern general systems (Ackoff, 1971; Bertalanffy, 1956; Boulding, 1956), open systems (Emery & Trist, 1965; Katz and Kahn, 1966; Thompson, 1967), living systems (Miller, 1978; Sommerhoff, 1969), and similar bodies of knowledge and points of view. Two principal concepts of the paradigm are the following:

(1) Systems may be classified according to their common properties. Thus by knowing the class (such as organizations) to which a system belongs, we know many of the system's properties (such as relatively stable distributions of hierarchical authority) without having observed the system itself.

(2) Systems of any hierarchical class or level possess not only the common properties of other systems at their level, but also possess the properties of their component lower-level systems (except as the properties of the components are modified through their relations with the whole). Thus if something belongs to a particular system-level (such as the organization level), it has all of the properties of organizations and also all of the properties of lower-level systems (such as humans), except as these latter properties (e.g., limited cognitive abilities) are modified by the relations that humans have with each other and with the organization.

Examples of such relations in this case, i.e., relations that modify the limited cognitive abilities of humans, are shared languages, complementary responsibilities, and memberships in heterogeneous work groups.

Formal use of the systems paradigm by organizational researchers has gone out of fashion. Although the classic works dealing with open systems are still cited in today's organization science writings, in the great majority of instances close scrutiny makes clear that this is generally done in passing--as a nod in the direction of a legitimizing reference point. The paradigm that was referred to in 1972 as "vital to the study of social organizations and as providing the major new paradigm for our field of study" (Kast & Rosenzweig, 1972, p. 457) has certainly not received the kind of attention in recent years that might have been expected of a "major new paradigm." Explicit recognition of the paradigm by organization scholars peaked in 1972 with the Academy of Management Journal's special issue on General Systems Theory. So why look back? Why re-examine an out-of-fashion paradigm?

There are three answers to these questions, three reasons for re-examining the systems paradigm. One follows from the need to retain high standards of scholarship in the field of organization theory. We find that prominent organization scientists have incorrectly described the work and thinking of early organization theorists, and have thereby perpetuated a number of mistaken beliefs. Scholarly integrity demands that these errors be corrected.

The second reason to look back at the systems paradigm is to identify aspects of the paradigm that have not been drawn upon by organization scholars but that might contribute to the development of organization

theory. We find several such opportunities available to organization researchers.

The third reason to re-examine the systems paradigm is to determine whether research and conceptualization subsequent to the paradigm's period of maximum visibility, the late 1960's and early 1970's, can be used to refine and enrich the paradigm itself, and thus make it more useful to organization scientists. We find that this is the case.

In response to the above, this paper has three purposes: (1) to identify and correct mistaken beliefs that have been perpetuated by organizational scholars in their writings concerning application of the systems paradigm to organizations, (2) to identify missed opportunities for using the systems paradigm to further the development of organization theory, and (3) to identify missed opportunities for using developments in organization theory to enrich and update the paradigm itself. Mistaken beliefs are those assumptions or attributions that organizational researchers have made about the systems paradigm and that are incorrect. Missed opportunities are contributions from the systems paradigm that could be made to further the development of organization theory, but that have not been so used.

MISTAKEN BELIEFS

The two mistaken beliefs discussed here involve the distinction between closed and open systems. Closed systems are, by definition, unaffected by their environments and correspond to Boulding's levels 1 and 2 (see Table 1). In contrast, open systems are affected by their environments (e.g., thermostats act on information from their environment) and are generally regarded as corresponding to Boulding's level 3 and above.¹

Insert Table 1 about here

Mistaken Belief #1: Early theorists incorrectly viewed organizations as closed systems.

Concurrent with the introduction of the systems paradigm to organization theory in the 1960's, organization scholars began labeling the earlier organization and management theorists (such as Taylor, Fayol, Weber and others) as incorrectly viewing organizations as closed systems:

Traditional organization theories have tended to view the human organization as a closed system. This tendency has led to a disregard of differing organization environments and the nature of organizational dependency on environment (Katz & Kahn, 1966, p. 29).

Referring to Taylor, Gulick, Urwick and Weber, Thompson stated that:

Since much of the literature about organizations has been generated as a by-product of the search for improved efficiency or performance, it is not surprising that it employs closed-system assumptions--employs the rational model--about organizations (1967, p. 4).

More recently Scott referred to the writings of the same early theorists:

Thus in all these models, the variety and uncertainty associated with an organization's openness to its environment is assumed or explained away (1981, p. 129).

These statements and others like them, however, do not accurately reflect the writings of the early theorists. There is substantial evidence, in fact, that the early theorists explicitly recognized the role of the environment. For example, Henry Fayol--one of the better known early management theorists and a major force in the development of the principles of management--wrote that:

The prosperity of an industrial concern often depends . . . on . . . a thorough knowledge of the market and of the strength of competitors . . . (1949/1916, p. 4).

James Mooney and Allan Reiley--early theorists whose classic book contains the most complete explication of the "principles" associated with the chain-of-command construct--made numerous references to the external environment. For example, in response to a question about the reasons for the success of American industry in mass production, they replied:

Prominent among the other factors are the quality of the immigration America has received from Europe . . . the political institutions . . . and our enormous free-trading area (1931, p. 430).

Fayol, and Mooney and Reiley took as their primary units of analysis corporations, and noted that these are influenced by consumers, competitors, incoming employees, political institutions--environments that interest today's open system theorists as well. In contrast, Fredrick W. Taylor focused on the shop, whose environment includes other corporate units as well as the corporation's environment:

We, however, who are primarily interested in the shop, are apt to forget that success, instead of hinging upon shop management, depends in many cases mainly upon other elements, namely, - the location of the company, its financial strength and ability, the efficiency of its business and sales departments, its engineering ability, the superiority of its plant and equipment, or the protection afforded either by patents, combination, location or other partial monopoly (1947/1911, p. 19).

These writings and others like them make clear that the early theorists did recognize the influence of the environment (see also Henderson and Parsons, 1947, p. 40, and Koontz, 1980, p. 180). To perpetuate the conclusion that they did not is to do all parties concerned, including today's students, a disservice.

It is instructive to remind ourselves that just as the contributions of the early theorists dealt primarily with internal variables, so do many of the contributions from today's organization scientists. For example, the literature continues to report many studies focused on structure or

technology (c.f., the reference lists of Fry, 1982, and Rousseau & Cooke, 1984). Are such studies "bad" because they portray the organization as a closed system by not explicitly accounting for environmental influences? Of course not. Any item from the literature can be faulted for not containing the reader's favorite variables. Even contingency theory studies tend to include consideration of only one or two of the focal organization's many environments, and with rare but conspicuous exceptions do not include consideration of important variables such as organizational culture, strategy, politics, and attributes of key members such as CEO's and boundary spanners. Every item in the organization theory literature uses simple models that do not account for some major variables.

Every model is inferior, a distortion, a lie. Why then do we bother with models? Ultimately, I propose we make models for their convenience (Ashby, 1970, p. 96).

The matter is straightforward--there is a difference between (1) believing that organizations are closed systems and (2) using closed system models of (open system) organizations. To imply that it was wrong for early theorists to use, on occasion, closed system models (especially given the complexities of the organizational issues they addressed relative to the theory they had to build upon) ignores the constraint that causes even today's scholars to work with closed system models:

Because of the limits of human intellectual capacities in comparison with the complexities of the problems that individuals and organizations face, rational behavior calls for simplified models that capture the main features of the problem without capturing all its complexities (March & Simon, 1958, p. 169).

The error that critics of early theorists make is not recognizing the difference between less complex systems of Table 1 (i.e., closed systems) on the one hand and closed-system models of more complex systems (e.g., organizations and other open systems) on the other hand. When today's

organization theorists focus, in any specific writing, on just a few of the variables relevant to organization theory, this does not mean that they regard other variables as non-existent or that other of their writings do not address additional variables. The same is true for the early systems theorists. Their views have been portrayed incorrectly.

Mistaken Belief #2: Open systems thinking has guided research on organizations.

It is commonly believed that open systems thinking has guided organization research. For example, in their critique of open systems models Pondy and Mitroff state, "for the last decade, thinking and research in the field of organization theory has been dominated by a point of view labeled as open system models" (1979, p. 10). This is a factual statement, but it may imply more than it actually says. Two points can be stated briefly.

(1) Although the open systems model has been widely used to label and legitimize organizational studies, it has seen little use as a research guide. In particular, while open systems have several properties important to organization research (see Table 2), very few organization studies have been guided by formal recognition of these properties as properties of open systems. The conspicuous exceptions are studies dealing with the sixth and eighth of Katz and Kahn's (1966) properties (information input and feedback, and differentiation), but topics related to information input and feedback (topics such as organizational intelligence, boundary spanning, and adaptation) and topics related to differentiation (topics such as specialization and coordination or integration) would undoubtedly have been studied without formal use of the open systems view.

Insert Table 2 about here

(2) While a large number of the studies that include considerations of the environment mention "open systems," hardly ever is it apparent that the studies were purposefully designed around open systems properties. Instead it seems that the studies were shaped by the common-sense idea that organizations are affected by their environments. Perhaps the studies were labeled by their authors as "open systems" studies because the phrase had come to impart a sense of being in vogue (and even today retains a "me too" positive valence). What caused research on organizations, beginning with that published during the 1970's, to focus rather suddenly and with such fanfare on organizational environments? Was it the emergence of the sharply articulated open systems view?

We think not. We suggest, to the contrary, that the association between (1) the proposed use of the open system properties and concepts and (2) the acceleration of research on organizational environments was not causal but rather temporal. Both events coincided temporally with recognition of the rapidly changing nature of organizational environments, as documented at the time by Toffler (1970) and Bell (1973), and more recently by others (c.f., Huber, 1984; and Naisbett, 1982).²

This labeling of studies that account for the environment as "open system" studies may have become a dysfunctional distraction for organization scholars. In 1972 Kast and Rosenzweig noted,

Unfortunately, there seems to be a widely held view (often more implicit than explicit) that open-system thinking is good and closed-system thinking is bad (Kast & Rosenzweig, 1972, p. 454).

Thus, rather than empirically examining the several properties of open systems, or instead of recognizing the usefulness of studies employing a closed-system model when this was not harmful given the researcher's goals and conclusions, the field seems to have gotten sidetracked with labeling studies and making value judgments about the studies based on the labels.

To suggest that the statements of respected authorities might be misleading, or that the field of organization theory has not been doing what conventional thinking says it has, is unsettling and unpopular. But pointing this out seems necessary to preserve the integrity of the field and to prevent future scholarly actions from being based on incorrect information or inferences.

This section has attempted to discredit what is "known" because what is "known" is contradicted by the facts. The current absence of organization studies that formally use the systems paradigm suggests that it is also "known" that the paradigm has been fully exploited. We believe to the contrary. We believe that opportunities for using the paradigm to further the development of organization theory have been missed and are being missed. Changing current thinking about the usefulness of the systems paradigm and then acting in accord with this changed thinking by drawing on the paradigm as a guide in conducting research on organizations would be a useful way of operationalizing Pondy and Mitroff's advice:

For the sake of maintaining organization theory's adaptability as an inquiring system (Churchman, 1971; Mitroff, 1974), we need to discredit what we know, to change for the naked sake of change to prevent ossification of our ideas (Pondy & Mitroff, 1979, p. 11).

Following this direction, let us suggest some directions for future research.

MISSED OPPORTUNITIES

Despite over half a century of effort, the study of organizations has produced disappointing results: findings generally have low explanatory power and are seldom associated with well-defined domains. We agree with McKelvey (1982) that the major reason for this is that the lack of a precise and widely applicable classification scheme impedes the comparison of studies, and thus thwarts the cumulation of knowledge. In contrast to organization theory, the systems paradigm has available precise and widely applicable classification schemes. Not drawing upon them means missed opportunities. Organization scholars should determine if the shortage of precise and widely applicable classification schemes in organization theory can be alleviated by borrowing from the systems paradigm.

Missed Opportunity #1: The features of living systems have not been exploited.

Although components of a living systems theory had been discussed as early as 1950 (Sommerhoff, 1950, 1968), a discussion of the living systems paradigm as it applies to organizations did not appear until 1972, the same year as the Academy of Management Journal's special issue on General Systems Theory was published (AMJ, 1972; Miller, 1972). This major subparadigm of the systems paradigm contains three features useful to organization researchers.

One of these features is an elaborate and precise typology of subsystems or components possessed by all living systems (see Table 3), wherever they may be situated in the seven-level hierarchy of the living systems paradigm (shown in Table 4). In his 150-page chapter on organizations, Miller (1978) discusses in great depth the function, the structure, and the processes of each of these universal components as they

occur in organizations and greatly enriches the typology beyond that portrayed in Table 3. Examination of Table 3, however, makes clear that the typology is considerably richer than many of the typologies used by organization researchers. Not only is it more detailed than classification schemes such as (1) R&D, production, marketing, (2) line and staff, and (3) strategic level, middle management level, operating level, but the relationships among the subsystems can be readily hypothesized. It seems that use of Miller's living systems to guide and interpret empirical studies on organizations is an unexploited opportunity. In addition, the broad range of its applicability as a descriptive schema for organizations (see Miller, 1972, 1978) indicates that it could greatly facilitate formal comparisons of research findings across studies, including literature reviews and meta-analyses, and thus respond to McKelvey's (1982) criticisms and concerns.

Insert Table 3 about here

Insert Table 4 about here

The second feature of the living systems paradigm that is of potential use is its rich descriptions of the additional properties possessed by each higher-order level in the living systems hierarchy. These descriptions could have guided and integrated, and could still guide and integrate, research on organizations. For example, Miller (1978, pp. 548, 642) and Gharajedaghi and Ackoff (1984, pp. 292, 293) note that organizations have as a property multiple deciders, while lower-level systems have single

deciders. Investigating how multiple deciders relate to one another would have led rather directly to research on conflict, coalitions, politics, and use of power, and to research that compared these phenomena at various levels in the living systems hierarchy. Investigating how organizations deal with the outputs of multiple deciders might have led to enriched studies of responsibility assignment, authority delegation, loose coupling, coordination, and related (within the multiple-decider property) constructs, and to alternative theoretical integrations of such studies. Sharper recognition and increased utilization of this feature of the living systems paradigm would not only enable organization scholars to develop theory more swiftly, but would avoid some of the pitfalls encountered when relying on biological analogies (c.f., Keeley, 1980).

The third feature of the living systems paradigm of potential usefulness to organization scientists is that much of what we learn about one living system level is found to hold for higher-order living system levels as well. This is, of course, a special case of the fact that systems generally possess, in modified form, the properties of their subsystems. The fact is of sufficient importance for developing organization theory that we treat it as a second missed opportunity:

Missed Opportunity #2: Cross-level hypotheses have not been employed.

Living systems theory "is a general systems theory of the organization because it utilizes a conceptual framework which is applicable across several levels of systems and it seeks to identify and support cross-level hypotheses which describe system behavior" (Duncan, 1972, p. 518). This latter feature offers the potential for organization scientists to benefit directly from the research findings of biologists, physiologists, and

psychologists who study lower-order systems and from the research findings of sociologists, economists, political scientists, and historians who study higher-order systems. In some instances this use of theories and findings from other disciplines might result in the identification of relationships not otherwise considered. In other instances the use could result in ascertaining relationships more precisely. In either case, it could speed up theory building.

As an example of how cross-level hypotheses might have been useful and still could be useful, consider the large number of studies which in the 1960's and 1970's examined the relationship between organizational size and either the administrative ratio or the staff-to-line ratio. Many of these studies seem exploratory, used simple correlational analyses, tested only for linear relationships, and found that the measured degree of association between the variables was not great. In addition, their definitions of "staff" or "non-direct" workers varied from study to study. Swifter and more informative results would have been obtained if the researchers studying the administrative ratio had begun with the following cross-level hypothesis: "Increase in the number of components in a (living) system requires a disproportionately larger increase in the number of information-processing and deciding components" (Miller, 1978, p. 109). This cross-level hypothesis (1) highlights the need to test for a non-linear relationship, (2) more precisely delineates how the administrative component might be operationalized, and (3) has been validated at several living system levels.

Moving from an "old" research topic to one not yet developed, we note that the organization literature contains very little information concerning the materials/energy distribution or logistical components of organizations,

even though these components greatly affect organizational efficiency and certainly add to the staff-to-line ratio. Development of descriptive theory concerning these components (called "distributors" by Miller, 1978, pp. 613-616) would undoubtedly be speeded if organization researchers attempted to draw on work in other disciplines, perhaps by testing the applicability of cross-level hypotheses such as

The hierarchical structure of the distributor is arranged so that there is a geometric progression from the size of the region of the total system served by an average unit of its lowest echelon to the size of the region served by its highest echelon (Miller, 1978, p. 94),

Even though organization scholars have a fairly extensive knowledge of information logistics (c.f., Huber, 1982), the relationships tend to be expressed less precisely than are those derived from a broader base of disciplines, such as

The structures of the communication networks of living systems at various levels are so comparable that they can be described by similar mathematical models of nonrandom nets (Miller, 1978, p. 95). (Miller goes on to describe one such mathematical model.)

It may be that organization scientists will not find interesting the testing of hypotheses found valid by scientists working at other system levels, or they may be unable to validate the more precisely formulated hypotheses borrowed from such scientists. It seems likely, however, that more rapid advances in organization theory could be made by drawing upon or expanding upon the knowledge of other disciplines.

We note that the idea of cross-level hypotheses is not limited to the living systems paradigm, but pertains to the general systems paradigm. This fact introduces the notion of system properties, to which we now turn.

Missed Opportunity #3: The properties of open systems have not been studied.

Table 2 lists nine properties that are said to distinguish open systems from closed systems. Very little actual use had been made of these properties by organization scientists. We suggest that organization researchers may be missing an opportunity. Although these properties are postulated as characterizing all open systems, it would be interesting to determine whether (1) the extent to which the properties are important, or (2) the degree to which the properties characterize different organizations, are variables that could enrich organization theory.

Consider for example, the open system property of "importation of energy, matter, and information" (Katz & Kahn, 1966; Miller, 1978). With respect to each of these three elements, organizations vary in how tightly connected they are to their environments; recognition of this fact led to the now-familiar phrase "loosely coupled" (Weick, 1979, p. 178).

Consider a world that is mainly "empty"--in which most events are unrelated to most other events; causal connections are exceptional and not common . . . "unrelated" is perhaps too strong a term, "loosely coupled" is a more appropriate one (March & Simon, 1958, p. 176).

The field of organizational theory could benefit from much more empirical exploration of the circumstances and consequences of the degree of an organization's connectedness to its environment. We see the beginnings of this with the development of the resource dependence perspective (Pfeffer and Salancik, 1978; Ulrich & Barney, 1984; Zammuto & Cameron, 1985), but relatively little empirical work has been published. Much more knowledge would now be available if organization researchers had studied this open system property when it was first brought to their attention (Glassman, 1973; Katz and Kahn, 1966; March and Simon, 1958; Meyer and Rowan, 1977; Weick, 1976). How long will we wait until other open systems properties are investigated?

Another open system property worth empirical investigation is equifinality, if for no other reason than that such investigation would force a deeper understanding of what equifinality means in the context of an organization. Equifinality is associated with the concept that "In an open system, the final state may be reached from different conditions and in different ways" (Shibutani, 1968, p. 332). Bertalanaffy (1962), Katz & Kahn (1966), and others have presented this as a property uniquely possessed by open systems, but recent work in organizational stories and myths (Pondy, L., Frost, P., Morgan, G., & Dandridge, T., 1983) suggests that organizations which attain equifinal states on certain objective measures may have greatly different perceptions and memories of how they got to these states. So, are they in fact in equifinal states? It seems to us that manifestation of organizational memories, such as stories and myths, require a broader conceptualization of equifinality. Confronting this apparent incongruence (between viewing organizations as open systems that possess the property of equifinality, on the one hand, and viewing organizations as learning systems whose memories or interpretations of how they achieved their otherwise observably-equivalent state, on the other hand) might enrich both our understanding of organizational learning and memory and also our understanding of the open system property of equifinality.

The three missed opportunities discussed up to this point center on the idea that examination of certain open system properties (such as equifinality) could lead to useful developments in organization theory. The last missed opportunity to be discussed concerns ways in which developments in organization theory could in turn be drawn upon to refine the systems paradigm (including re-examining the definition and domain of equifinality).

Missed Opportunity #4: Relevant advances in organization theory have not been used to enrich and update the systems

paradigm and thereby make it more useful to organization scholars.

Since the glory days of the paradigm in the late 1960's and early 1970's, research on organizations has led to new knowledge and insight. There has been no attempt, however, to transfer this new understanding into the systems paradigm and thereby enrich an adjacent field of study. Here we discuss two developments in organization theory literature as examples of how the paradigm could be enriched and updated: (1) the construct of organizational culture and (2) the notion of strategic choice. Undoubtedly there are others as well.

The organizational culture construct at first seems far removed from the systems paradigm, but in a few particulars it is not. For example, the construct has led to a heightened awareness of the importance in organizations of myths and stories (Martin, Feldman, Hatch, and Sitkin, 1979) and similar notions of organizational memory. Such notions are thought to be important both in attaining organizational stability (Peters and Waterman, 1982; Pondy, 1983) and in creating organizational change (Orwell, 1945; Toffler, 1985; Tunstall, 1983). Given this importance and these beliefs, it is appropriate to reconsider the established systems paradigm concept that "When open systems reach a steady state and show equifinality, the final state will be independent of the initial conditions" (Kramer and de Smit, 1977, p. 40). Is the systems paradigm valid for organizations? Are organizations that "look the same" actually the same if they arrived at their current state via different paths? If Apple Computer becomes an IBM, will it ever forget its roots? Such questions raise interesting issues beyond the scope of this paper, but clearly suggest that the open systems property of equifinality (Katz and Kahn, 1966, p. 25-26)

must be reconsidered. It may be, in fact, that equifinality does not apply to systems that have memories, i.e., systems at the higher end of Boulding's ordinal scale of system complexity (or at the higher end of Miller's hierarchy of living systems). If the equifinality property does not apply to systems with memories (e.g., animals, humans, societies), , either (1) the property must be dropped from its long-established position in the properties of open systems (Bertalanffy, 1950; Katz and Kahn, 1966, p. 25-26), or (2) the class of systems called open systems must be redefined and not applied without qualification to organizations and other systems having memories. Whatever the consequences, determining how organization theory's recognition of organizational memories or cultures should affect the conceptual association between equifinality and open systems will enrich the systems paradigm.

The notion of strategic choice (Child, 1972) can and should also be used to enrich the systems paradigm. Familiar as this notion was to executives (c.f., Barnard, 1938; Sloan, 1946), it held an element of surprise for many organization scientists because it did not fit comfortably within the dominant paradigm of the time--the systems-structural perspective (Astley and Van de Ven, 1983). The strategic choice notion certainly did fit, however, within the systems paradigm with its elaborate and rigorous treatment of deciders (Miller, 1978, p. 548, 642) and purposeful systems (Ackoff, 1971; Sommerhoff, 1969). Since the early 1970's, organization scientists have made significant advances in their understanding of organizational decision making and strategy choosing (c.f., Miller and Freisen, 1982; Mintzberg, Raisinghani, and Theoret, 1976; Nutt, 1984). An examination of systems theorists' writings on decider behavior in purposeful systems (see especially Ackoff, 1971, p. 665-666, 670-671; and Miller, 1972,

p. 60-85) makes clear that some of the empirically-based knowledge generated by organization scientists could be used to enrich the systems paradigm with regard to multiple deciders in organizations and, via cross-level hypotheses, in higher-level living systems as well.

To summarize, developments in organization theory over the past decade or so have not been used to extend or enrich the formal systems paradigm, and thus increase the likelihood of its usefulness to organization scientists, even though it seems that such attempts might be fruitful.

CONCLUSION

Examination of the organization theory and systems literatures revealed two mistaken beliefs that have been prominent in the organization theory literature and that require correcting lest they be perpetuated and cause future scholarly actions to be based on incorrect information or inferences. The examination also identified several concepts and frameworks offered by the systems paradigm that have not been exploited by organization scholars but that seem potentially fruitful, and some developments in organization theory that seem to show promise for enriching the systems paradigm itself.

In 1972 Kast and Rosenzweig, looking back on the progress of systems thinking, quoted the psychologist Murray,

I am wary of the word "system" because . . . "system" is a highly cathected term, loaded with prestige; hence, we are all strongly tempted to employ it even when we have nothing definite in mind and its only service is to indicate that we subscribe to the general premise respecting the interdependence of things (Kast and Rosenzweig, 1972, p. 455).

Review of the recent organization theory literature indicates that the word "system" is no longer loaded with prestige and that the formal systems paradigm is receiving little attention. At the outset of our work we might have hypothesized that the reason for its low visibility was because the

paradigm itself lacked substance and was perhaps more metaphor and language for talking about organizations than it was a theoretical framework for understanding and studying organizations. A closer examination, however, revealed features and components of the systems paradigm, such as the properties of open systems and the universal subsystems typology of the living systems paradigm, that offer potential for enriching future organization research. However, in order to most fruitfully utilize the systems paradigm of organizations, scholars in the field must re-examine their beliefs about the paradigm and perhaps re-educate themselves about how to think about and study organizations as systems.

Footnotes

¹Pondy and Mitroff (1979) argue that open systems are not only affected by, but also affect, their environment, e.g., flames deplete their environment of oxygen, and thus open systems correspond only to levels 4 and above.

²During earlier periods, the periods known to the early organization and management theorists, environmental factors were generally of much less significance than internal variables. In particular, during the first third of the century the laissez-faire philosophy of the United States toward business and the rapidly growing and relatively protected domestic markets prompted early theorists to view organizations as only loosely coupled to their environments. However, during the 1960's and 1970's, the same period that the open systems view was articulated and the same period that saw references to this view burgeon in the organization literature, organizational environments became much more complex, turbulent, and demanding of attention.

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Table 1
Boulding's Scale of System Complexity

COMPLEX SYSTEMS

-
- 9 Transcendental Systems - Complex systems not yet imagined
 - 8 Social Organizations - Collections of individuals acting in concert
(e.g., human groups)
 - 7 Symbol Processing Systems - Systems conscious of themselves (e.g.,
humans)
 - 6 Differentiated Systems - Internal image systems with detailed awareness
of the environment (e.g., animals)
 - 5 Blue-Printed Growth Systems - Systems with a division of labor among
cells (e.g., plants)
 - 4 Open Systems - Self maintaining structures in which life differentiates
itself from nonlife (e.g., cells)
 - 3 Control Systems - Cybernetic systems which maintain any given
equilibrium within limits (e.g., thermostats)
 - 2 Clockworks - Simple dynamic systems with predetermined, necessary motions
(e.g., levers and pulleys)
 - 1 Frameworks - Static structures (e.g., organization chart)
-

SIMPLE SYSTEMS

(Adapted from Boulding, 1956, and Pondy & Mitroff, 1979)

Table 2

Properties of Open Systems

1. Importation of energy	Open systems import energy from the external environment.
2. Through-put	Open systems transform the energy available to them.
3. Output	Open systems export some product into the environment.
4. Systems as cycles of events	The pattern of activities of the energy exchange has a cyclic character.
5. Negative entropy	To survive, open systems must move to arrest the entropic process.
6. Information input, and negative feedback,	Inputs furnish signals to the structure about the environment and about its own functioning in relation to the environment. Negative feedback enables the system to correct its deviations from course.
7. Steady state, and dynamic homeostatis	The importation of energy to arrest entropy operates to maintain some constancy in energy exchange. At more complex levels the steady state becomes one of preserving the character of the system through growth and expansion.
8. Differentiation	Open systems move in the direction of differentiation and elaboration.
9. Equifinality	A system can reach the same final state from differing initial conditions and by a variety of paths.

(Adapted from Katz and Kahn, 1966)

Table 3

MILLER'S UNIVERSAL SUBSYSTEMS
OF LIVING SYSTEMS

Type of sub- system	Subsystem	Function	Examples in Organizations
SUBSYSTEMS THAT PROCESS INFORMATION	Input Transducer	Receives information from the system's environment.	Market research dept. Complaint dept.
	Internal Transducer	Receives information from other subsystems about alterations in their status.	Bookkeeper; payroll dept.
	Channel & net	Transmits information to all parts of the system.	Switchboard operator; gossip
	Decoder	Alters the code of information received by input transducer into a system code.	Language translator; signal officer
	Associator	Carries out first stage of learning process, forming associations among items of information.	Intelligence analyst; chief executive officer
	Memory	Carries out second stage of learning process, storing information.	Filing dept.; data input operator
	Decider	Receives information inputs from all other subsystems and transmits information outputs that control entire system.	Board of directors; executive
	Encoder	Alters the code of information input from subsystems, changing "private" code to "public" that can be interpreted by environmental components.	Advertising dept.; public relations expert
	Output Transducer	Changes information into other matter-energy forms that can be transmitted over channels in environment.	Salesperson; Publication dept.

--continued

Table 3--continued

SUBSYSTEMS THAT PROCESS BOTH INFORMATION AND MATTER-ENERGY	Reproducer	Gives rise to other systems similar to the one it is in.	Member of organization who sets up a subsidiary
	Boundary	Located at perimeter; holds components together, protects, permits entry	Personnel office; Purchasing dept.
SUBSYSTEMS THAT PROCESS MATTER-ENERGY	Ingestor	Brings matter-energy across boundary.	Recruiter; Receiving dock
	Distributor	Carries inputs from outside or transports outputs around the system.	Fork lift operator; Elevator operator
	Converter	Changes inputs into functional form.	Training dept.; Heating plant operator
	Producer	Forms stable associations among inputs or outputs for purposes of growth, damage repair or replacement of components.	Hospital nurse; Maintenance worker
	Storage	Retains deposits of matter-energy in the system.	Stockroom or warehouse
	Extruder	Transmits matter-energy out of system in the form of wastes or products.	Shipping department; hospital discharge unit
	Motor	Moves system in relation to its environment.	Executive jet pilot
	Supporter	Maintains proper spatial relationships among components of system.	(No living supporter known at this level); office building, aircraft carrier

(Adapted from Miller, 1978)

Table 4

Miller's Hierarchical Levels of Living Systems

-----HIGHER LEVEL MACRO SYSTEM-----	
<u>System Level</u>	<u>Definition</u>
Supranational System	Two or more societies, some or all of whose processes are under the control of a decider that is superordinate to their highest echelons.
Society	Large, living concrete system with organizations and lower levels of living systems as subsystems and components.
Organization	System with multi-echelon deciders whose components and subsystems may be subsidiary organizations, groups and single persons.
Group	Set of single organisms which, over a period of time, relate to one another face-to-face, processing matter-energy information.
Organism	Organized multi-cellular structure that has single decider.
Organ	Cells aggregated into tissue which carries out the processes of a given sub-system of an organism.
Cell	Simplest level of living systems, consisting of atoms, molecules, multimolecular organelles.
-----LOWER ORDER MICRO SYSTEMS-----	

(Adapted from Miller, 1978)



THE UNIVERSITY OF TEXAS AT AUSTIN
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*Vice President for Academic
Affairs and Research*

January 29, 1985

Dr. Edgar M. Johnson
U. S. Army Research Institute for
the Behavioral & Social Sciences
Room 6N-30
5601 Eisenhower Avenue
Alexandria, Virginia 22333

Gentlemen:

We are pleased to transmit a proposal prepared by George P. Huber and William H. Glick of our Department of Management. This proposal has the approval of cognizant officials of the University.

Further information relating to the technical portions of this proposal may be obtained from either Dr. George P. Huber or Dr. William H. Glick, Department of Management, The University of Texas at Austin. Contractual matters should be referred to the Office of Sponsored Projects, The University of Texas at Austin, Post Office Box 7726, Austin, Texas 78713-7726. (Phone: 512/471-1353.)

Sincerely yours,

G. J. Fonken
Vice-President for
Academic Affairs and Research

GJF:cg

Enclosures

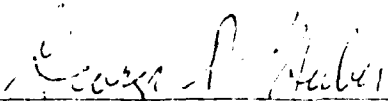
xc: Dr. George P. Huber
Dr. William H. Glick
Mr. T. M. Grady/Comptroller

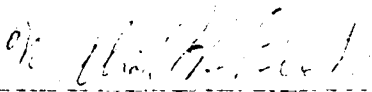
ORGANIZATIONAL DESIGN:

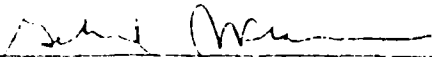
Proposed Theoretical and Empirical Research

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APPENDIX G(4) - Vita of Andrew Van de Ven	
APPENDIX G(5) - Vita of Karl E. Weick	

ORGANIZATIONAL DESIGN
Proposed Theoretical and Empirical Research

Abstract

This document proposes a program of research to be undertaken on behalf of and with support from the Army Research Institute for the Behavioral and Social Sciences. The proposed research focuses on organizational design. The objective is to improve in social scientists' understanding of organizational design and administrators' ability to design more effective organizations.

The proposed program of research has eight unique and important features.

1. The most important issues in organizational design will be investigated by uniquely qualified researchers chosen from around the country, rather than from the local talent at one university or consulting firm.
2. The researchers (the principal and co-principal investigator and the four associate principal investigators) will each be supported by a team of consultants consisting of five nationally recognized scholars specially selected from around the country for their ability to contribute to a program of research on organizational design.
3. The program of research will be an integrated and coordinated effort, rather than being a set of unrelated projects. The principal and co-principal investigator and the consultants will be in frequent contact with the associate principal investigators. Further, all investigators and consultants will meet together annually to report, review, assess, and revise as necessary their individual and collective efforts. This rich exchange of perspectives and constructive suggestions will enhance the quality of both the individual and collective research efforts.
4. The involvement of multiple investigators makes it possible to conduct an integrated study using data drawn from a very large and diverse set of organizations. This will eliminate problems of small sample size and range restriction of the variables, problems that occur in most organizational design studies.
5. The program emphasizes longitudinal studies of organizational design. The advantages and infrequency of longitudinal research are well known, especially in the area of organizational design.
6. Where appropriate, the empirical results will be analyzed using both multivariate statistical techniques and data envelopment analysis.
7. The multiplicity of studies will allow for the planned development of a contingency theory that accounts for differences in

organizational missions, strategies, technologies, and environments.

8. The planned derivation of normative organizational design guidelines will provide immediate benefits to the administrative community, without compromising basic research objectives.

Hardly any of the above features and outcomes would occur if the subject of organizational design were approached with the independent, cross-sectional studies that pervade the field.

INTRODUCTION AND OVERVIEW

This document proposes a program of research to be undertaken on behalf of and with support from the Army Research Institute for the Behavioral and Social Sciences.

The proposed research focuses on organizational design. The objective is to improve in social scientists' understanding of organizational design and administrators' ability to design more effective organizations.

The research team consists of the following nationally recognized authorities in the area of organizational science and research methodologies: Dr. Kim S. Cameron, Professor William W. Cooper, Dr. Richard L. Daft, Dr. William H. Glick, Dr. George P. Huber, Dr. Alan D. Meyer, Dr. Peter R. Monge, Dr. Charles A. O'Reilly, III, Dr. John W. Slocum, Jr., Dr. Andrew H. Van de Ven, and Dr. Karl E. Weick. These eleven scholars, representing eight different universities, have disciplinary backgrounds in psychology, sociology, organizational communications, industrial engineering, and operations research, and all are currently involved in fields of organizational behavior and design.

Why Study Organizational Design?

The research is focused on organizational design for six reasons:

1. The design of an organization directly impacts managers' ability to coordinate and control the activities of subordinates to enhance organizational performance. Proper organizational design can make the difference between having an effective, well-run organization and having recurrent crises and organizational inefficiencies.

- To increase organizational effectiveness, we must learn more about how to design organizations.
- 2. Organizational environments are changing more rapidly than ever before. We already know that the effectiveness of an organizational design erodes over time as the environment changes. The organization must be designed to fit current and future environmental demands, not the environment of the past.
- To increase organizational effectiveness, we must learn more about the types of organizational designs that fit different environments.
- 3. Innovative technologies are continuously being introduced in modern organizations. The effectiveness of different organizational designs depends on the technology and how the work is done.
- To increase organizational effectiveness, we must learn more about the relationships between technology and organizational design.
- 4. Modern communication and computing technologies facilitate the process of coordination and control and make new organizational designs feasible. New communication and computing technologies can also increase organizational effectiveness in current or previously abandoned organizational designs.
- To increase organizational effectiveness, we must learn more about the impact and potential of new communication and computing technologies.
- 5. Changing organizational designs to meet new challenges and opportunities involves a dynamic process. The effectiveness of an organizational design is partially a function of procedures

established in the past and the training and experience provided organizational members by the previous organizational design.

- To increase organizational effectiveness, we must learn more about dynamic processes between organizational design and effectiveness over time.
- 6. Organization design is becoming a much-talked-about topic among social science researchers, but good inventories, analyses, or codifications or the relevant literatures do not exist. There is little guidance to identify the most fruitful areas of investigation.
- To increase organizational effectiveness, organizational design research must be reviewed and codified to direct new research efforts.

Key Features of the Program of Research

The proposed program of research has eight unique and important features.

1. The most important issues in organizational design will be investigated by uniquely qualified researchers chosen from around the country, rather than from the local talent at one university or consulting firm.
2. The researchers (the principal and co-principal investigator and the four associate principal investigators) will each be supported by a team of consultants consisting of five nationally recognized scholars specially selected from around the country for their ability to contribute to a program of

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3. The program of research will be an integrated and coordinated effort, rather than being a set of unrelated projects. The principal and co-principal investigator and the consultants will be in frequent contact with the associate principal investigators. Further, all investigators and consultants will meet together annually to report, review, assess, and revise as necessary their individual and collective efforts. This rich exchange of perspectives and constructive suggestions will enhance the quality of both the individual and collective research efforts.
4. The involvement of multiple investigators makes it possible to conduct an integrated study using data drawn from a very large and diverse set of organizations. This will eliminate problems of small sample size and range restriction of the variables, problems that occur in most organizational design studies.
5. The program emphasizes longitudinal studies of organizational design. The advantages and infrequency of longitudinal research are well known, especially in the area of organizational design.
6. Where appropriate, the empirical results will be analyzed using both multivariate statistical techniques and data envelopment analysis.
7. The multiplicity of studies will allow for the planned development of a contingency theory that accounts for

differences in organizational missions, strategies, technologies, and environments.

8. The planned derivation of normative organizational design guidelines will provide immediate benefits to the administrative community, without compromising basic research objectives.

In closing we note that hardly any of the above features and outcomes would occur if the subject of organizational design were approached with the independent, cross-sectional studies that pervade the field.

CHANGES IN ORGANIZATIONAL ENVIRONMENTS

Organizational structures, processes, and technologies facilitate and constrain organizational actions. The proposed program of research will deal with the relationships of organizational structures, processes, and technologies to organizational effectiveness. These relationships are clearly affected by the nature of the organization's environment, as it is the intersection of organizational actions and environmental states that determines organizational effectiveness. As a consequence, we must consider the nature of future organizational environments in determining the most important issues to be investigated.

We can expect future organizational environments to be characterized by more and increasing information, more and increasing complexity, and more and increasing turbulence. In combination, these trends will pose qualitatively more demanding organizational environments. These demands will have to be met, at least in part, by changes in organizational designs.

Available Information -- More and Increasing.

It would be incorrect to interpret the Information Explosion as a "recent trend." Consider, for example, scientific information. As reported by de Solla Price (1963), the first two scientific journals appeared in the mid-seventeenth century. By the middle of the eighteenth century there were ten scientific journals, by 1800 about 100, by 1850 perhaps 1,000. Today estimates range between 30,000 and 100,000 (Bell, 1979). Nor is this explosion likely to diminish in the

intermediate future. Further, since information feeds on itself, we can expect the absolute amount of information to continue to rise. That is, even when (or if) the rate of increase declines, the existing information base will be so large that absolute increases in units of information per unit of time will remain large throughout at least the first half of the next century and very likely far beyond that.

Of equal or greater importance, for the proposed research, is the fact that communications and computing technologies, about which more will be said, will greatly increase the availability of whatever information is produced. Since these technologies are in their early stages, in terms of both their effectiveness and their adoption, we must also anticipate a sudden increase in the availability of existing information as these distribution technologies mature and become widely used. The increased adoption of knowledge-distribution technology, superimposed on the geometrically increasing knowledge base, will necessarily result in an information environment that is dramatically more munificent (or burdening) than is that of today. It is the generally unconsidered combination of these two phenomena that will cause the future information environment of organizations to be qualitatively different from what has been experienced in the past; in future organizational environments society both the amounts of available information and its absolute growth will be significantly greater than in the past.

Complexity -- More and Increasing

For the purposes of analysis it is useful to view environmental

complexity as having three characteristics: numerosity, diversity, and interdependence. Systems theory reminds us that these tend to be related to each other, e.g., "As the system's components become more numerous, they become specialized, with resulting increased interdependence . . ." (Miller, 1972, p. 5). An examination of these characteristics and their relationships indicates that organizational environments of the future will necessarily be much more complex. Consider, for example, numerosity. Whether or not environmental components in general will become more numerous is unclear, in spite of current short-term tendencies for some types to increase. If some do, such as humans or corporations, our conclusion that organizational environments will be more complex will to some extent be confirmed. Aside from whether or not the actual number of components will be greater, however, it does seem clear that communications and transportation technologies will cause the "effective" number of environmental components to be greater.

The major increases in the complexity of future organizational environments will not, however, arise solely from or depend on increases in numerosity. They also will follow from increases in diversity and interdependency. New knowledge leads to increases in specialization and diversity. In strictly biological systems this new knowledge or information is generated through mutation, hybridization, evolution, i.e., through biological innovation, and is conveyed in the form of genetic code. In human-made systems it is generated through experience and research and is conveyed in the form of extra-genetic records. The

large increase in available information discussed earlier will lead to a large increase in environmental diversity, as it will enable individual societal components, such as other organizations, to identify and exploit technological, economic, and social niches, much as genetic changes enable biological organisms to identify and exploit ecological niches. Thus we can anticipate more and increasing specialization and diversity in the environment as a result of more and increasing information, whether or not there is an increase in numerosity.

Finally, let us consider interdependence. Specialization results in interdependence because as living systems specialize, they give up certain capabilities (or do not achieve commensurate growth in certain capabilities) and must rely on other system components for the resources that they themselves can no longer provide. Thus the anticipatable increases in specialization noted above will necessarily lead to increased interdependencies. In addition, potential increases in physical interdependence may lead to increases in societal interdependence (Mesarovic and Pestel, 1974; Kahn, Brown, and Martel, 1976). For example, possible increases in the ratio of demand to supply of certain limited resources (such as metals or croplands) may create interdependencies for future environmental components beyond those experienced today.

In summary, the following seem clear: (1) the anticipatable large increases in information will lead to large increases in technological, economic, and social specialization and diversity; these increases may be facilitated by increases in the effective numerosity of environmental

components, and (2) these large increases in specialization and diversity will lead to large increases in the interdependence among environmental components; these latter increases may be aggravated by increases in the demand-supply ratio of certain physical resources. As a consequence of these arguments we can conclude that in future organizational environments both the level of complexity and its absolute growth rate will be significantly greater than in the past.

Turbulence -- More and Increasing

Increased turbulence will follow from increases in the rapidity of individual events. We recall that organizational environments in the future will be characterized by more and increasing knowledge. This will cause many technologies to be more effective. An important consequence of these heightened levels of effectiveness will be that individual events will be shorter in duration. They will transpire more quickly. For example, improvements in R&D technology, in advertising technology, and in distribution technology will enable competitors to steal markets even more quickly than they can today, and some high-technology military engagements will be subject to completion in a matter of moments. The role of geographical distance and even cultural differences as "time buffers" will be greatly diminished as improved communication and transportation technologies are implemented on a near-universal scale. Since shorter events permit more events per unit of time, the eventual effect of increased knowledge is increased turbulence. In combination, then, our earlier reviews of forthcoming increases in the number and diversity of societal components and in the

growth of knowledge cause us to conclude that in future organizational environments both the level of turbulence and its absolute growth rate will be significantly greater than in the past.

Implications of Changes in Organizational Environment

What are the organizational implications of the fact that future organizational environments will be characterized by more and increasing knowledge, complexity, and turbulence? Contingency theory and systems theory both tell us that for an organization to survive, it must be compatible with its environment. When the environment changes to a state that is incompatible with the organization, the organization has available a variety of strategies including: (1) adapting to the changed demands, (2) moving to a different environment, (3) changing the environment to a more compatible state, or (4) relying on slack, loose couplings, or other buffers. Selection among these and other coping strategies require that decision be made. The greater turbulence of future environments will demand that organizational decision making be more frequent and faster. The greater complexity of this environment will also cause decision making to be more complex (e.g., to require consideration of more variables and more complex relationships among these variables).

Some decisions will concern fairly radical changes in the technologies, processes, and structures that the organization employs. The heightened turbulence of environments will require that these organizational adaptations be more frequent and faster.

Organizations require information to decide when decisions and

adaptations are needed, and decision makers require information to reach conclusions. The increased turbulence of future environments will cause organizational information acquisition to be more continuous, and the increased complexity will cause it to be more wide-ranging. At the same time, however, the information richness of the environment may create problems of overload, both on the organization's sensors and on the receivers of messages from these sensors. This necessitates more effective management of organizational information acquisition, processing, and distribution.

In the preceding paragraphs we examined the nature of future organizational environments, and then proceeded to determine the demands that these environments will impose on organizations. In summary, the demands of future organizational environments will require the purposeful design of organizations so as to increase the effectiveness of their (1) decision making, (2) adaptation, and (3) information acquisition and distribution functions.

MANAGEMENT PLAN

Overview

The program of work consists of conducting and reporting: (1) a major literature review, (2) six conceptual and empirical studies, and (3) two major conferences.

The conceptual and empirical work will take two forms. One form will be the conduct of five multi-organizational longitudinal studies, with each study being carried out by a different investigator. These studies will each deal with aspects of organizational design approved by the principal and co-principal investigators. (Four of these studies will be conducted by associate principal investigators and one by the principal and co-principal investigators working together). The second form of the conceptual and empirical work will be the conduct of a very large-scale collective study, designed by the principal and co-principal investigators with inputs from all associate principal investigators and consultants. The data associated with this study will be collected as part of the data collection for the five individual studies.

Coordination of these six studies will be achieved by annual review and planning meetings of all investigators and consultants, regular phone discussions, and the exchange of drafts of plans, progress reports, and comments.

The Individual Studies

The program of research proposed here will result in a considerable increase in knowledge for selecting organizational designs that increase the effectiveness of the decision making, adaptation, and information

acquisition and distribution functions. Before describing the year-by-year workplan, as an indication of what the program of research entails, and to demonstrate its orientation to these issues, we include here brief quotes from the five proposals of the Principal, Co-Principal, and Associate Principal Investigators.

Proposal from Dr. Kim S. Cameron, Associate Principal Investigator #1

The research being proposed here focuses on these three issues that have been neglected in past organizational design research. The intent is to address three primary research questions in this investigation:

1. What design elements cluster together in different organizations and under different environmental conditions, and what is the relationship between this congruence and organizational effectiveness?
2. What modifications in traditional organizational designs emerge in post-industrial environments, and how does the transition from an industrial design to a post-industrial design occur?
3. What are the major paradoxes that emerge under different environmental conditions, especially post-industrial environments, and how are those paradoxes managed?

As can be seen, this study will examine the relationships among organizational environments, design changes, design paradoxes (seemingly incompatible design features), and organizational effectiveness. The full proposal is contained in Appendix B-1.

Proposal from Dr. Richard L. Daft, Associate Principal Investigator #2

The purpose of the research proposed here is to develop and test a model of organizational scanning and interpretation. The research will be focused on how organizations learn about the external environment, and on the role of information technology and organizational design in the interpretation process. The research program will focus on three research questions.

1. How do organizations learn about the external environment, and does the interpretation process differ between high and low performing organizations? The point here is to construct a

basic map or communication audit of the techniques and sources for learning about the environment, and to determine whether the pattern of interpretation differs in a systematic way based on organizational success. Methods of scanning and interpretation in environments characterized as complex and rapidly changing will be sought.

2. How do advanced communication and computing technologies fit into the scanning and interpretation process? The issue here is the role played by these technologies, and whether they extend or inhibit the organization's insight into the environment. What value is provided by advanced technology compared to more traditional information systems based on paperwork and face-to-face discussions?
3. What is the impact of information processing technology on organizational design and internal culture? The issue here is to explore how the adoption of communication technology influences working relationships, the number of positions in the hierarchy, and the allocation of personnel between line and staff departments. Moreover, communication technology may depersonalize communications in a way that could have undesirable effects on the organization's culture and social relationships.

As can be seen, this study will examine in considerable depth the relationships among organizational environments, organization design, and organization information acquisition and distribution. The full proposal is contained in Appendix C-1.

Proposal from Dr. Alan D. Meyer, Associate Principal Investigator #3

The proposed research investigates the effects of organizational design, intelligence, and ideology on organizational adaptation to environmental changes. The issues it addresses are growing in importance. Today's organizations face more and more turbulent and complex environments than ever before (Duncan, 1976). These trends appear likely to persist (Huber, 1984). If they do, they will magnify the consequences of system-wide adaptation for organizational effectiveness, telescope the time available to top managers for responding, and reduce the effective half-life of organizational designs (Starbuck and Nystrom, 1981).

Fickle environments favor nimble organizations. Prior research suggests two design characteristics that may distinguish such organizations: (1) Sophisticated intelligence systems enable the gathering, processing, and distribution of large volumes of diverse

information concerning environmental change (Daft and MacIntosh, 1978; Galbraith, 1973; Miles and Snow, 1978). (2) Robust organizational ideologies foster shared values and high levels of commitment that inspire individual members to accept change and respond adaptively (Beyer, 1981; Meyer, 1982a; Starbuck, Greve, and Hedberg, 1978). This study will formulate and test theory linking intelligence, ideology, and other design characteristics to organizational adaptiveness.

As can be seen, this study will examine the relationships among organizational design, intelligence (acquired and processed information), ideologies (learned premises for decision making), and adaptiveness. The full proposal is contained in Appendix D-1.

Proposal from Dr. Charles A. O'Reilly, Principal Investigator #4

The essence of the problem is understanding the relationship among goals, controls, and rewards, all conceptualized in terms of information acquisition and use. What goals are set? What measurements are taken? What functions are provided? What information is transmitted about the accomplishment of established goals? In this view, organizational structure is reduced to the information set defining targets and the connective signals transmitted (e.g., Anderson & O'Reilly, 1982). Centralization and decentralization are seen in terms of how goals are set and the extensivity of information transmitted in controlling and correcting task objectives.

Although a number of researchers have proposed that organizations be viewed as sociometric networks defined by information flow (e.g., Huber, 1984; Mackenzie, 1978; O'Reilly & Pondy, 1980), no research has explicitly focused on goals, controls, rewards, and the information exchanged in this process. Yet, understanding how goals are set and what information is exchanged seems to be at the core of understanding variations in organizational performance. The research proposed here will examine these concepts, focusing on the acquisition and use of information by superior and subordinate decision makers; that is, a principal or executive decision maker and his agents or direct reports.

As can be seen, this study focuses on the acquisition and use of information for making decisions about the design of goal, control, and reward systems and for monitoring and controlling the effectiveness of organizational subunits. The full proposal is contained in Appendix E-1.

Proposal from Drs. William H. Glick, and George P. Huber, Co-Principal and Principal Investigators

Managers' ability to respond to future environmental changes and to coordinate more diverse organizational activities will be a function of their ability to effectively redesign organizational information acquisition and distribution units. The patterning or structuring of communication and work relations is crucial to the effective functioning of organizations.

To be prepared for these environmental changes, we must develop a better understanding of the relationships among environmental characteristics, the relational structures of work and information flows, and organizational effectiveness. On a practical, yet theoretically important level, this translates into questions such as:

How should managers restructure the patterns of communication and authority relations to ensure effective distribution and utilization of information about the environment?

Under what circumstances should environmental scanning be concentrated in specialized units, versus being distributed throughout the organization?

Do new communications and computing technologies replace or simply reinforce existing communication patterns?

Should patterns of communication always be structured to coincide with the patterns of work flow relations, or are there situations where more elaborate relationships between work flow and information flow are required?

As can be seen, this study will examine the relationships among organizational design features (e.g., authority relations, specialization of scanning units, work flows), information acquisition, distribution and utilization, and advanced information handling technologies that maximize organizational effectiveness.

THE YEAR-BY-YEAR WORK PLAN

Year 1 (9/85 - 8/86)

During the first year of the research the Principal Investigator, Dr. George P. Huber, and co-principal investigator, Dr. William H. Glick, will undertake an extensive and intensive review of the literature on organizational design and related subjects. This review will identify the critical weaknesses in the organizational design literature and will enable Drs. Glick and Huber to manage the overall program of research more effectively.

A number of important products will follow from the first year's work. Four scholarly articles in social science journals will report the results of literature reviews concerning (a) organization design as an independent variable affecting organizational effectiveness, contingent upon the organization's goal or mission and the organization's environment, (b) organization design as a dependent variable affected by the organization's core technology and communications technology, (c) organization design as a dependent variable affected by organizational learning and need for adaptation, and (d) organization design as a strategic management process. Each of these four articles will identify high priority conceptual and empirical research needs. A fifth product will be a detailed technical report to ARI integrating the above products and elaborating on the identified needs. The content of this report will guide Drs. Glick and Huber in the management of the overall program of research and will guide all

investigators in the refinement of their individual and collective studies.

As an indication of the realizability of these Year 1 products, we note that previous funding by ARI to Dr. Huber has led to scholarly articles concerning (a) organization design as a dependent variable affected by environmental complexity and turbulence (Huber, 1984), and (b) organization design as dependent variable affected by the organization's need to make decisions and process information (Huber and McDaniel, forthcoming in 1985), along with, of course a number of other research products (cf. Huber, 1983; Huber, 1982; Huber, 1981). As a further indication we note Dr. Glick's critical literature reviews (Roberts and Glick, 1981; Glick, 1984; Glick, in press) and subsequent award winning empirical research (Jenkins, Glick and Gupta, 1983).

At the end of Year 1, all investigators and consultants will meet to: (1) review the results of the year's work by Drs. Glick and Huber and any related conceptual work undertaken by the associate principal investigators, (2) make any necessary refinements to the five individual studies based on what was learned in this effort, (3) contribute to refining the design of the integrative, collective study using, again, the results of the first year's work, and (4) arrive at a mutually agreed upon work plan for Year 2.

Also, at the end of the year, ARI will conduct a technical review to assess the results of the previous year's work and the plans for the following year's work.

Year 2 (9/87 - 8/87)

Year 2 will be the first year of empirical work. Six longitudinal studies will be initiated, the five individual (but coordinated) studies described in Appendices B through F and an integrative, collective study that will draw on data from the individual studies. During this year, conceptualization and instrument development and pretesting will take place. In addition, the first wave of longitudinal data will be collected.

The empirical work will be conducted with the assistance of six doctoral students working under the guidance of established researchers. Such empirical work is ideally suited to Ph.D. dissertation research, thereby insuring that these research assistants will be exceptionally motivated. Each empirical study is budgeted for three years to provide continuity from conceptualization through completion of the longitudinal research and to guide sequences of dissertations where applicable. The budgeting of the established investigators across time also allows the study of problems identified as important but whose full investigation may be too drawn out or risky for a Ph.D. student.

At the end of Year 2, all investigators and consultants will meet again. This meeting will focus on:

1. the annual review and progress assessment of the individual studies, the collective study, and the overall project;
2. the annual refinement of the individual and collective studies and the development of a mutually agreed upon work plan for each study for the forthcoming year based on what has been

learned during the previous year.

Also, at the end of the year, ARI will conduct a technical review to assess the results of the year's work and the plans for the following year's work.

Year 3 (9/87 - 8/88)

Year 3 will be a very active year with respect to continuing data collection for each of the six empirical studies.

Toward the end of Year 3, a major working conference will be held. At this conference the program of research and its interim results will be shared with 45 scholars from around the world. Each of the six studies and the associated interim results will be described, and tentative hypotheses will be set forth concerning the implications of the work completed during the first three years. Authorities in organizational design and related areas will review and discuss the state of the field of organizational design, and the manner in which the described studies contribute to the advancement of knowledge in the field.

At the end of Year 3, all investigators and consultants will meet again. This meeting will focus on:

1. the annual review and progress assessment of the individual studies, the collective study, and the overall project;
2. the annual refinement of the individual and collective studies and the development of a mutually agreed upon work plan for each study for the forthcoming year based on what has been learned during the previous year.

Also, as before, ARI will conduct a technical review to assess the results of the previous year's work and the plans for the following year's work.

Year 4 (9/88 - 8/89)

Year 4 will involve collecting the final waves of data from the individual and collective studies, analyzing these data, and writing the results of the individual empirical studies for publication in scientific and professional journals. The data analysis and the research reporting will be coordinated across the five empirical studies so as to exploit the opportunities for synergism that a program of research such as that proposed here, offers.

At the end of Year 4, all investigators and consultants will meet again. This meeting will focus on:

1. the annual review and assessment of where the individual studies, the collective study, and the overall project stand;
2. the annual refinement of the individual and collective studies and the development of a mutually agreed upon work plan for each study for the forthcoming year based on what has been learned during the previous year.

Also, as before, ARI will conduct a technical review to assess the results of the previous year's work and the plans for the following year's work.

Year 5 (9/89 - 8/90)

Three activities will take place in Year 5. The first will be the analysis of the data from the sixth integrative, collective empirical study, and the preparation of additional papers for publication in scientific and professional journals.

The second activity will be the writing of a book on organizational design. The book will be based on all six empirical studies and will contain contributions from all of the investigators and consultants. This will be a major work, published by an academic or commercial press. It will have a major impact on organizational science and will be the definitive work on organizational design.

The third activity will be the holding of another major conference. The purpose of this conference will be to enhance transfer of the knowledge and "technology" developed through the program of research described in this proposal. The majority of the 45 attendees will be military officers, management consultants, and practitioners in the defense establishment. Other attendees will include all of the investigators and consultants involved in the six studies and some of the authorities from the conference held in Year 3.

PERSONNEL

Principal and Co-Principal Investigators

The Principal Investigator will be Dr. George P. Huber of the University of Texas at Austin. Dr. Huber will be responsible for the overall management of the project and will take the primary role in providing the five products to be developed during Year 1. Dr. Huber is uniquely qualified to manage the program of research proposed here, as he has both experience in research administration and expertise in organizational design. With respect to research administration, Professor Huber has been the principal investigator for multi-investigator projects funded by the U.S. Department of Labor and by the National Institutes of Health, has been a co-investigator in multi-investigator projects sponsored by the Ford Foundation and by the National Institutes of Health, has served as a research policy consultant to the U.S. Department of Labor and the National Science Foundation, and for four years was Associate Dean for Research in the Graduate School of Business of the University of Wisconsin-Madison. With respect to organizational design, Dr. Huber has conducted both laboratory and field research in organizational design, has consulted for a variety of organizations on this topic, and has published a number of conceptual pieces, including his award-winning article on the nature and design of post-industrial organization. His vita is contained in Appendix A(1).

The Co-Principal Investigator will be Dr. William H. Glick of the University of Texas at Austin. Dr. Glick is one of the country's

fastest-rising young scholars in the organizational sciences. He is currently the Principal Investigator for a \$137,000 multi-investigator research project on work and information flow in organizations (to be completed by December, 1985), has recently agreed to write one of the chapters in the forthcoming Handbook of Organizational Communications, and was co-author of an award-winning research paper in 1983. Dr. Glick will assist Dr. Huber in managing the overall project and will assume equal responsibility with Dr. Huber in designing, coordinating, and conducting the empirical studies. His vita is contained in Appendix A-2.

Associate Principal Investigators

Dr. Kim S. Cameron of the University of Michigan will be one of the Associate Principal Investigators. Dr. Cameron is the country's foremost authority on organizational effectiveness and how it is affected by organizational design. He has conducted research and published extensively on this and related subjects. Before assuming his present position at the University of Michigan, Dr. Cameron served as Director of the Organizational Studies Division of the National Center for Higher Education. In 1981, Dr. Cameron was the winner of an international competition for the best paper on organizational design. Dr. Cameron received his doctorate from Yale University. His vita is contained in Appendix B(2).

Dr. Richard L. Daft is one of the country's most respected young scholars in the area of organization theory and design, having reached

the position of being one of two Associate Editors for the most prestigious journal in the organizational science field, the Administrative Science Quarterly, less than ten years after receiving his doctorate. His book, Organization Theory and Design, is recognized as one of the most substantial texts on the topic. Dr. Daft received his doctorate from the University of Chicago. His vita is contained in Appendix C(2).

Dr. Alan D. Meyer of the University of Oregon is the country's best known young scholars in the area of organizational adaptation. Although he just received his doctorate in 1978, two of his articles have already been reprinted in books and two have won awards. In addition, he serves on the editorial boards of two of the most highly respected journals in organizational science, the Academy of Management Review and the Administrative Science Quarterly. Dr. Meyer received his doctorate from the University of California-Berkeley. His vita appears as Appendix D(2).

Dr. Charles A. O'Reilly of the University of California-Berkeley is the country's most highly regarded scholar in the area of organizational communications and the effects of communications on organizational decision making. He is frequently asked to write chapters on this and related topics for scholarly reference books, and also has a long history of doing first-rate empirical work and publishing it in the most prestigious outlets. Dr. O'Reilly received his doctorate from the University of California-Berkeley and taught at UCLA for some years before returning. His vita is contained in Appendix E(2).

Consultants

The consultants are so eminently well qualified and well known that no more than a sentence or two, linking their special talents to the program of research, seems appropriate.

Dr. W. W. Cooper of the University of Texas at Austin is, along with his colleague Dr. Abraham Charnes, the inventor of goal programming and, now, inventor of Data Envelopment Analysis (DEA), a linear programming methodology that can be used to address questions concerning organizational effectiveness and the determinants of effectiveness for a given set of organizations. This DEA methodology has been used in a variety of private sector and military studies of organizational effectiveness. It will be used, in parallel with multivariate statistical analyses, in the program of research described here to gain insights into organizational effectiveness that may not be available using only traditional techniques. Dr. Cooper is an internationally known scholar with over 200 publications.

Dr. Peter R. Monge of the Annenberg School of Communications at the University of Southern California is the country's leading authority on longitudinal research, a methodology that will characterize the empirical studies described here and that will facilitate the identification of causal linkages in ways not possible with the cross-sectional studies that pervade the literature on organizational design.

Dr. John W. Slocum, Jr. of Southern Methodist University and past President of the Academy of Management, was previously Editor of the

Academy of Management Journal and recently edited a special issue of the Journal of Management entitled Organizational Design.

Dr. Andrew Van de Ven of the University of Minnesota is one of the country's foremost authorities on organizational structure and process and is currently Principal Investigator for a half million dollar multi-investigator study of organizational innovation for the Office of Naval Research.

Dr. Karl E. Weick of the University of Texas at Austin is the Editor of the Administrative Science Quarterly and known as one of the nation's most creative thinkers in the area of organizational structure and process.

Each of these authorities possesses special expertise relevant to the program of research. Each has agreed to participate. Their memoranda to participate as consultants and their vitae appear in Appendices G-1 through G-5 respectively.

SUMMARY

This proposal begins with an enumeration of six reasons for studying organization design. These seem persuasive from either a theory-building or administrative point of view, and need not be repeated here.

The plan of work associated with the research described in this proposal begins with an extensive examination of the literature, proceeds with five parallel and coordinated empirical investigations and an integrating empirical investigation, and concludes with the writing of an important book on organizational design. Other products will include scholarly articles following from the review and empirical studies and two major meetings, one directed toward the research community and one toward the practitioner community.

The key features of the research, such as its being a coordinated program rather than a specific project, being longitudinal, having multiple investigators each with multiple field sites, and involving eleven of the most qualified people in the field, will cause it to provide a major increase in knowledge about organizational design.

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UNIVERSITY OF TEXAS BL TOTAL AND GRAND TOTAL

	Year 1 (9/85 - 8/86)	Year 2 (9/86 - 8/87)	Year 3 (9/87 - 8/88)	Year 4 (9/88 - 8/89)	Year 5 (9/89 - 8/90)	Total Project Expenses
SENIOR PERSONNEL						
George Huber	(5/8) \$50,400 (1/4)	\$21,168 (1/4)	\$22,227 (1/4)	\$23,338 (5/8)	\$61,262 (5/8)	\$178,395
Bill Ghok	(1/4) \$11,025 (5/8)	\$28,941 (1/4)	\$12,155 (1/4)	\$12,763 (5/8)	\$33,503 (5/8)	\$98,387
OTHER PERSONNEL						
Research Assistant II	(1/2) \$9,122 (1/2)	\$9,579 (1/2)	\$10,057 (1/2)	\$10,560 (1/2)	\$11,088 (1/2)	\$50,406
Research Assistant II	(1/2) \$9,122 (1/2)	\$9,579 (1/2)	\$10,057 (1/2)	\$10,560 (1/2)		\$39,318
Administrative Secretary	(Full) \$15,511 (Full)	\$16,286 (Full)	\$17,100 (Full)	\$17,955 (Full)	\$18,853 (Full)	\$85,705
TOTAL SALARIES & WAGES	\$95,180	\$85,553	\$71,596	\$75,176	\$124,706	\$452,211
Fringe Benefits at 24%	\$22,843	\$20,533	\$17,183	\$18,042	\$29,929	\$108,530
Leave & Vac. at 7%	\$666	\$599	\$501	\$526	\$873	\$3,165
TOTAL PERSONNEL COSTS	\$118,689	\$106,685	\$89,280	\$93,744	\$155,508	\$563,906
TRAVEL						
Air Travel Expenses	\$3,982	\$2,190	\$4,550	\$4,550	\$4,550	\$19,822
Other Travel Expenses	\$798	\$798	\$798	\$798	\$798	\$3,990
TOTAL TRAVEL	\$4,780	\$2,988	\$5,348	\$5,348	\$5,348	\$23,812
CONFERENCE						
Domestic Participants Airfare			\$26,000		\$19,500	\$45,500
Foreign Participants Airfare			\$8,250			\$8,250
Other Travel			\$14,130		\$7,530	\$21,660
TOTAL CONFERENCE			\$48,380		\$27,030	\$75,410

UNIVERSITY OF TEXAS BL TOTAL AND GRAND TOTAL

	Year 1 (9/85 - 8/86)	Year 2 (9/86 - 8/87)	Year 3 (9/87 - 8/88)	Year 4 (9/88 - 8/89)	Year 5 (9/89 - 8/90)	Total Project Expenses
OTHER DIRECT COSTS						
Supplies	\$1,000	\$1,500	\$1,500	\$1,500	\$500	\$6,000
Computer Time	\$500	\$1,000	\$1,000	\$1,000	\$1,000	\$4,500
Consultants	\$2,700	\$2,700	\$2,700	\$2,700	\$2,700	\$13,500
TOTAL OTHER DIRECT COSTS	\$4,200	\$5,200	\$5,200	\$5,200	\$4,200	\$24,000
SUB-CONTRACTORS						
Univ. of Michigan	\$1,600	\$24,640	\$25,792	\$90,944	\$1,600	\$144,576
Univ. of Oregon	\$1,692	\$29,204	\$31,193	\$33,361	\$1,692	\$97,142
Texas A&M	\$1,539	\$43,951	\$45,985	\$46,670	\$1,539	\$139,684
Univ. of CA, Berkeley	\$4,831	\$36,949	\$39,646	\$41,131		\$117,726
TOTAL SUB-CONTRACTORS	\$4,831	\$134,744	\$142,616	\$212,106	\$4,831	\$499,128
TOTAL DIRECT COSTS	\$132,500	\$249,617	\$290,824	\$316,398	\$196,917	\$1,186,256
INDIRECT COSTS AT 42%	\$55,440	\$87,798	\$61,827	\$43,383	\$80,256	\$328,704
TOTAL YEAR BUDGET	\$187,940	\$337,415	\$352,651	\$359,781	\$277,173	\$1,514,960
GRAND TOTAL BUDGET	<u>\$1,514,960</u>					<u>\$1,514,960</u>
NOTES:						
1. Budget explanation and details are on following pages.						
Detailed budget for the four subcontract proposals are included in Appendices B1, C1, D1, and E1.						

Budget Explanation

Year 1: September 1, 1985 to August 31, 1986

Personnel¹

Senior Personnel

George Huber (Principal Investigator)		
7.5 mo. @ \$6720		\$50,400
William Glick (Co-Principal Investigator)		
3 mo. @ \$3675		11,025

Other Personnel

Research Assistant II	6 mo. @ \$1520	9,122
Research Assistant II	6 mo. @ \$1520	9,122
Administrative Secretary	12 mo. @ \$1293	15,511
Total Salaries and Wages		95,180

Fringe Benefits	@ 24%	22,843
Leave and Vacation	@ 0.7%	666
Total Benefits		23,509

Total Personnel Costs		118,689
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Travel

Air Travel for the purpose of conducting annual project meeting to be held in Chicago in conjunction with August 1986

Academy of Management Meetings

George Huber	(Austin to Chicago)	584
William Glick	(Austin to Chicago)	584
Karl Weick	(Austin to Chicago)	584
John Slocum	(Dallas to Chicago)	530
Peter Monge	(Los Angeles to Chicago)	806
William Cooper	(Austin to Chicago)	584
Andrew Van de Ven	(Minneapolis to Chicago)	310
Total Air Travel		3,982

Ground transportation from O'Hare to downtown hotel district @ \$14	98
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Lodging and per diem for seven project participants for one day each @ \$100	700
Total Other Travel	798

Total Expenses for Annual Project Meeting	4,780
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Other Direct Costs

Supplies	1,000
Computer time on IBM 3081 .67 hrs. @ \$750	500
Total Supplies and Computer Time	1,500

Consultants: Three days each to attend meeting and provide critical feedback on project reports		
John Slocum	3 days @ \$300	900
Peter Monge	3 days @ \$300	900
Andrew Van de Ven	3 days @ \$300	900
Total Consultants		<u>2,700</u>

Sub-Contracts		
University of Michigan (Kim Cameron, Assoc. PI)		1,600
University of Oregon (Alan Meyer, Assoc. PI)		1,692
Texas A&M (Richard Daft, Assoc. PI)		<u>1,539</u>
Total Sub-Contracts		<u>4,831</u>

Total Other Direct	<u>9,031</u>
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Total Direct Costs	132,500
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Indirect Costs ²	<u>55,440</u>
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Total Year 1 Budget	187,940
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¹ Wages, salaries, lodging, and per diem's based on 5% per annum increase over University of Texas allowable base rates for September 1984 to August 1985.

² Provisional indirect cost rate for the contract year based on current predetermined rate. Indirect cost rate is 42% of Modified Total Direct Costs (total direct cost less computer time and less subgrant costs in excess of \$25,000 over the life of the subgrant). Note that University of Texas indirect costs on subgrants appear only in years 1 and 2.

Year 2: September 1, 1986 to August 31, 1987

Personnel¹

Senior Personnel

George Huber (Principal Investigator)
3 mo. @ \$7056 \$21,168

William Glick (Co-Principal Investigator)
7.5 mo. @ \$3859 28,941

Other Personnel

Research Assistant II 6 mo. @ \$1596 9,579

Research Assistant II 6 mo. @ \$1596 9,579

Administrative Secretary 12 mo. @ \$1357 16,286

Total Salaries and Wages 55,553

Fringe Benefits @ 24% 20,533

Leave and Vacation @ 0.7% 599

Total Benefits 21,132

Total Personnel Costs 106,685

Travel

Air Travel for the purpose of conducting annual project meeting to be held in New Orleans in conjunction with August 1987

Academy of Management Meetings

George Huber (Austin to New Orleans) 180

William Glick (Austin to New Orleans) 180

Karl Weick (Austin to New Orleans) 180

John Slocum (Dallas to New Orleans) 180

Peter Monge (Los Angeles to New Orleans) 734

William Cooper (Austin to New Orleans) 180

Andrew Van de Ven (Minneapolis to New Orleans) 556

Total Air Travel 2,190

Ground transportation from airport to downtown hotel district @ \$14 98

Lodging and per diem for seven project participants for one day each @ \$100 700

Total Other Travel 798

Total Expenses for Annual Project Meeting 2,988

Other Direct Costs

Supplies 1,500

Computer time on IBM 3081 1.33 hrs. @ \$750 1,000

Total Supplies and Computer Time 2,500

Consultants: Three days each to attend meeting and provide critical feedback on project reports

John Slocum 3 days @ \$300 900

Peter Monge 3 days @ \$300 900

Andrew Van de Ven 3 days @ \$300 900

Total Consultants 2,700

Sub-Contracts	
University of Michigan (Kim Cameron, Assoc. PI)	24,640
University of Oregon (Alan Meyer, Assoc. PI)	29,204
Texas A&M (Richard Daft, Assoc. PI)	43,951
University of California at Berkeley (Charles O'Reilly, Assoc. PI)	<u>36,949</u>
Total Sub-Contracts	134,744
Total Other Direct Costs	<u>139,944</u>
Total Direct Costs	249,617
Indirect Costs ²	<u>87,798</u>
Total Year 2 Budget	337,415

¹ Wages, salaries, lodging, and per diem's based on 5% per annum increase over University of Texas allowable base rates for September 1984 to August 1985.

² Provisional indirect cost rate for the contract year based on current predetermined rate. Indirect cost rate is 42% of Modified Total Direct Costs (total direct cost less computer time and less subgrant costs in excess of \$25,000 over the life of the subgrant). Note that University of Texas indirect costs on subgrants appear only in years 1 and 2.

Year 3: September 1, 1987 to August 31, 1988

Personnel¹

Senior Personnel

George Huber (Principal Investigator)
3 mo. @ \$7,409 \$22,227

William Glick (Co-Principal Investigator)
3 mo. @ \$4,052 12,155

Other Personnel

Research Assistant II 6 mo. @ \$1,676 10,057

Research Assistant II 6 mo. @ \$1,676 10,057

Administrative Secretary 12 mo. @ \$1,425 17,100

Total Salaries and Wages 71,596

Fringe Benefits @ 24% 17,183

Leave and Vacation @ 0.7% 501

Total Benefits 17,684

Total Personnel Costs 89,280

Travel

Air Travel for the purpose of conducting annual project meeting to be held in similar city in continental U.S. in conjunction with August 1988 Academy of Management Meetings

George Huber (Austin to Major City) 650

William Glick (Austin to Major City) 650

Karl Weick (Austin to Major City) 650

John Slocum (Dallas to Major City) 650

Peter Monge (Los Angeles to Major City) 650

William Cooper (Austin to Major City) 650

Andrew Van de Ven (Minneapolis to Major City) 650

Total Air Travel 4,550

Ground transportation from airport to downtown hotel district 98

Lodging and per diem for seven project participants for one day each @ \$100 700

Total Other Travel 798

Total Expenses for Annual Project Meeting 5,348

Third Year Conference

Air Travel for Third Year Conference to be held in major city in continental U.S.

40 participants from various cities in North America @ \$650 26,000

5 participants from other countries @ \$1,650 8,250

Total Air Travel 34,250

Ground transportation to downtown hotel district for 45 project participants @ \$14	630
Lodging and per diem for 45 project participants for 3 days each @ \$100 per day	<u>13,500</u>
Total Other Travel	<u>14,130</u>

Total Expenses for Third Year Conference	48,380
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Other Direct Costs

Supplies	1,500
Computer time on IBM 3081 1.3 hrs. @ \$750	<u>1,000</u>
Total Supplies and Computer Time	<u>2,500</u>

Consultants: Three days each to attend meeting and provide critical feedback on project reports	
John Slocum 3 days @ \$300	900
Peter Monge 3 days @ \$300	900
Andrew Van de Ven 3 days @ \$300	<u>900</u>
Total Consultants	<u>2,700</u>

Sub-Contracts

University of Michigan (Kim Cameron, Assoc. PI)	25,792
University of Oregon (Alan Meyer, Assoc. PI)	31,193
Texas A&M (Richard Daft, Assoc. PI)	45,985
University of California at Berkeley (Charles O'Reilly, Assoc. PI)	<u>39,646</u>
Total Sub-Contracts	<u>142,616</u>

Total Other Direct Costs	<u>147,816</u>
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Total Direct Costs	290,824
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Indirect Costs ²	<u>61,827</u>
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Total Year 3 Budget	352,651
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¹ Wages, salaries, lodging, and per diem's based on 5% per annum increase over University of Texas allowable base rates for September 1984 to August 1985.

² Provisional indirect cost rate for the contract year based on current predetermined rate. Indirect cost rate is 42% of Modified Total Direct Costs (total direct cost less computer time and less subgrant costs in excess of \$25,000 over the life of the subgrant). Note that University of Texas indirect costs on subgrants appear only in years 1 and 2.

Year 4: September 1, 1988 to August 31, 1989

Personnel¹

Senior Personnel

George Huber (Principal Investigator)
3 mo. @ \$7,779 \$23,338

William Glick (Co-Principal Investigator)
3 mo. @ \$4,254 12,763

Other Personnel

Research Assistant II 6 mo. @ \$1,760 10,560

Research Assistant II 6 mo. @ \$1,760 10,560

Administrative Secretary 12 mo. @ \$1,496 17,955

Total Salaries and Wages 75,176

Fringe Benefits @ 24% 18,042

Leave and Vacation @ 0.7% 526

Total Benefits 18,568

Total Personnel Costs 93,744

Travel

Air Travel for the purpose of conducting annual project meeting
to be held in similar city in continental U.S. in conjunction
with August 1989 Academy of Management Meetings

George Huber (Austin to Major City) 650

William Glick (Austin to Major City) 650

Karl Weick (Austin to Major City) 650

John Slocum (Dallas to Major City) 650

Peter Monge (Los Angeles to Major City) 650

William Cooper (Austin to Major City) 650

Andrew Van de Ven (Minneapolis to Major City) 650

Total Air Travel 4,550

Ground transportation from airport to
downtown hotel district 98

Lodging and per diem for seven project
participants for one day each @ \$100 700

Total Other Travel 798

Total Expenses for Annual Project Meeting 5,348

Other Direct Costs

Supplies 1,500

Computer time on IBM 3081 1.3 hrs. @ \$750 1,000

Total Supplies and Computer Time 2,500

Consultants: Three days each to attend meeting and
provide critical feedback on project reports

John Slocum 3 days @ \$300 900

Peter Monge 3 days @ \$300 900

Andrew Van de Ven 3 days @ \$300 900

Total Consultants 2,700

Sub-Contracts	
University of Michigan (Kim Cameron, Assoc. PI)	90,944
University of Oregon (Alan Meyer, Assoc. PI)	33,361
Texas A&M (Richard Daft, Assoc. PI)	46,670
University of California at Berkeley (Charles O'Reilly, Assoc. PI)	<u>41,131</u>
Total Sub-Contracts	<u>212,106</u>
Total Other Direct Costs	<u>217,306</u>
Total Direct Costs	316,398
Indirect Costs ²	<u>43,383</u>
Total Year 4 Budget	359,781

1 Wages, salaries, lodging, and per diem's based on 5% per annum increase over University of Texas allowable base rates for September 1984 to August 1985.

2 Provisional indirect cost rate for the contract year based on current predetermined rate. Indirect cost rate is 42% of Modified Total Direct Costs (total direct cost less computer time and less subgrant costs in excess of \$25,000 over the life of the subgrant). Note that University of Texas indirect costs on subgrants appear only in years 1 and 2.

Year 5: September 1, 1989 to August 31, 1990

Personnel¹

Senior Personnel

George Huber (Principal Investigator)
7.5 mo. @ \$8,168 \$61,262

William Glick (Co-Principal Investigator)
7.5 mo. @ \$4,467 33,503

Other Personnel

Research Assistant II 6 mo. @ \$1,848 11,088

Administrative Secretary 12 mo. @ \$1,571 18,853

Total Salaries and Wages 124,706

Fringe Benefits @ 24% 29,929

Leave and Vacation @ 0.7% 873

Total Benefits 30,802

Total Personnel Costs 155,508

Travel

Air Travel for the purpose of conducting annual project meeting
to be held in similar city in continental U.S. in conjunction
with August 1989 Academy of Management Meetings

George Huber (Austin to Major City) 650

William Glick (Austin to Major City) 650

Karl Weick (Austin to Major City) 650

John Siocum (Dallas to Major City) 650

Peter Monge (Los Angeles to Major City) 650

William Cooper (Austin to Major City) 650

Andrew Van de Ven (Minneapolis to Major City) 650

Total Air Travel 4,550

Ground transportation from airport to
downtown hotel district 98

Lodging and per diem for seven project
participants for one day each @ \$100 700

Total Other Travel 798

Total Expenses for Annual Project Meeting 5,348

Fifth Year Conference

Air Travel for Fifth Year Conference to be held in Washington D.C.

15 local participants @ \$0	0
30 out of town participants @ \$650	19,500
Total Air Travel	<u>19,500</u>

Local ground transportation for 45 participants @ \$14	630
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Lodging and per diem for 30 participants for 2 days each @ \$100 per day	6,000
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Per diem for 15 local participants for two days each @ \$30	900
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Total Other Travel	<u>7,530</u>
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Total Expenses for Fifth Year Conference	27,030
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Other Direct Costs

Supplies	500
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Computer time on IBM 3081 1.33 hrs. @ \$750	1,000
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Total Supplies and Computer Time	<u>1,500</u>
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Consultants: Three days each to attend meeting and provide critical feedback on project reports

John Slocum 3 days @ \$300	900
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Peter Monge 3 days @ \$300	900
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Andrew Van de Ven 3 days @ \$300	900
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Total Consultants	<u>2,700</u>
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Sub-Contracts

University of Michigan (Kim Cameron, Assoc. PI)	1,600
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University of Oregon (Alan Meyer, Assoc. PI)	1,692
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Texas A&M (Richard Daft, Assoc. PI)	1,539
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Total Sub-Contracts	<u>4,831</u>
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Total Other Direct Costs	<u>9,031</u>
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Total Direct Costs	196,917
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Indirect Costs²	80,256
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Total Year 5 Budget	277,173
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¹ Wages, salaries, lodging, and per diem's based on 5% per annum increase over University of Texas allowable base rates for September 1984 to August 1985.

² Provisional indirect cost rate for the contract year based on current predetermined rate. Indirect cost rate is 42% of Modified Total Direct Costs (total direct cost less computer time and less subgrant costs in excess of \$25,000 over the life of the subgrant). Note that University of Texas indirect costs on subgrants appear only in years 1 and 2.